TECHNICAL EDUCATION

ITS AIMS ORGANISATION AND FUTURE DEVELOPMENT

P. F. R. VENABLES
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PRINCIPAL · COLLEGE OF TECHNOLOGY · BIRMINGHAM

WITH FIVE CHAPTERS
BY SPECIALIST AUTHORS

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Our economic survival depends on the rapidly increasing application of science and technology in industry. Technical education therefore has become vitally important. Provision for it has greatly increased since pre-war days, but new and still greater developments are urgently required. The end of the first post-war decade makes this thorough survey of the facts, achievements and deficiencies, present and future trends of technical education, both timely and important.

How many students are there in technical education and what kind of schools do they come from? What should be the relationship between technical colleges and the secondary schools? What kinds of full-time day, part-time day and evening courses are provided, and what sort of qualifications can be gained? Can they provide another route to higher education for those "who fail the eleven-plus examination"? What training schemes are provided by industry and commerce, what opportunities for promotion do they afford? How do industry and the colleges work together, and could they co-operate more effectively?

What hope is there of County Colleges? What is a "sandwich" course, and what is the difference between a National Diploma and a National Certificate; What is a City & Guilds Full Technological Certificate? How do technical college courses lead to professional qualifications and status? What "wastage" is there in courses, and how can the selection and

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P. F. R. VENABLES, PH.D., B.SC., F.R.I.C.
Principal, College of Technology, Birmingham

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PREFACE

During the last few decades we have lived in a world of increasingly rapid change, and, as if by some untoward application of Heisenberg's Uncertainty Principle, we have become increasingly uncertain of our position and the direction of future development, in the world at large and in the sphere of education. The ever-growing application of science and technology has been the main agent both of change and of the increasing rate of change; and this not simply in the material sense of providing new machinery of production, fertilisers, new materials and services to raise the standards of living, but more profoundly in a world-wide and rapid dissemination of knowledge and ideas, beliefs and values. These two aspects of development must be seen in technical education if it is to meet present and future needs; the one to secure a high competence in the relevant science and technology, production and distribution, design and management for each particular level of industry and commerce; and the second to provide an education worthy of humankind so that our students' lives will gain in meaning and purpose, in joy and understanding.

The inherent uncertainties in gauging so rapidly changing a situation might seem to absolve us from any attempt to determine our present position or the directions of change. On the contrary we should not add ignorance or unawareness to uncertainty; it is the modest hope of the authors of this book that it will do something to make known the present state and likely developments of technical education and to show how far (or how little) we have progressed towards these high ideals. Though technical education is but a small sector of the whole field of education, it nevertheless has a lasting significance in meeting the economic needs of the country through industry and commerce, and in the importance that work and education for work must always have in the individual lives of innumerable people. At the present time, however, it has a peculiar importance and it seemed desirable, especially in view of the extraordinary differences from pre-war days, to describe the scene as best we may, and hope to convey something of its significance. Undoubtedly some of the information will soon become dated, as those with new buildings recently opened or soon to be available will feel most keenly. But history is apt to be dated, and otherwise would be distressingly amorphous: contemporary accounts are not without value, however humanly inaccurate they may be.

Technical education is directly concerned with the vast human enterprises of industry, trade and commerce, and altogether some 1,200,000 students attended courses of all kinds, art, commerce, technical, etc., in technical institutions in 1952–3. No one person can competently cover so large and richly diverse a field, especially in its technical aspects and, for this reason, I was happy to enlist the help of five fellow principals in dealing with certain specialist subjects in Chapters VIII to XII respectively. These chapters, together with the sciences in Chapter XIII, cover most of the work of most of the colleges in greater technical detail than is possible in the rest of the book. Chapter XIII exemplifies the acute problem of diversity with its 27 different technologies and crafts, and necessarily attempts to give no more than a summary account of each and to provide the sources of authoritative information for those especially interested. Discussions on policy as the determination of the direction and rate of change of development are as fascinating as they are important, but it is hoped they do not occupy a disproportionate place. Two prime conditions must never be forgotten in all the welter of current controversy—an insistence on high standards and a personal regard for our students. Though it is also hoped that these essentials are not lost sight of in the rest of the book, Chapter VII on Selection and Placement and Chapter XVII on Students' Needs and Problems are intended to focus attention on matters of personal as well as general educational importance.

Technical education is indeed fortunate in the extent and quality of its partnerships, which Chapter V (Partnerships in Technical Education), Chapter VI (Industry and Education) and Chapter XVI (Freedom and Governance, Finance and Administration) are severally intended to convey. In the particular work of writing this book we have been most fortunate in enjoying a sense of partnership with many colleagues and friends in our colleges, the secretaries of many Professional Institutions, of the Examining Bodies and of the Regional Advisory Councils and many voluntary associations. The Ministry of Education has been most helpful in supplying information as also have been many engaged in industry, trade and commerce. We had hoped to make personal acknowledgement to all those who have so readily supplied information to us but the list is so long that exigencies of space and publishing costs make this quite impossible. We hope they will accept this sincere expression of our grateful thanks.

Nevertheless, there are some acknowledgements which I wish to make more specifically. First I am very indebted to those who have kindly granted permission to use material as set out on pages xi–xii, which gives valuable point and illustration to the text. Secondly I am most grateful to Mr. A. W. Gibson, O.B.E., and Dr. F. Briers, who have given so much personal time and assistance in the detailed preparation of the book. They read most of the chapters (excepting VIII to XII) in first draft and I profited greatly from the criticisms and suggestions which they troubled to make despite the great pressure on their time and energies. Professor C. A. Mace read the final drafts of Chapter VII (Selection and Placement in Technical Education) and Chapter XVII (Students' Needs and Problems) and I am very glad to acknowledge his help in this way, as indeed from many discussions on technical education in which he is so interested. Mr. Noel Hill, F.R.I.B.A., very kindly checked Chapter XIX on Buildings and Equipment. Dr. A. Harvey has helped very much with sources of information. Mr. W. P. Jennings, M.Sc., has willingly read and commented on the part of Chapter III relating to Secondary Technical Schools. The whole of the final draft has been read critically by Mrs. Venables, M.Sc., and at least other authors who are similarly placed will understand how superfluous and inadequate, not to say how inappropriate, would be a public expression of my thanks to her. My indebtedness to many authors will be self-evident from the references in the text, but I owe a personal debt to Mr. H. C. Dent through his writings and his encouragement, and through stimulating discussions with him from time to time over the last ten years or so.

However, none of the foregoing is in any way responsible for any inadequacies or inaccuracies in this present volume; I hardly expect to escape either, nor yet to please everyone or even many on controversial matters. I can only hope that such defects do not mar the general presentation of the important and fast-growing work of technical education, and I shall be grateful to receive any suggestions for the improvement of any future edition.

To the staff of the Royal Technical College, Salford, I am indebted for their support, for many interesting discussions, and for their care of students which is a continuing source of encouragement. In particular I record my thanks to Mr.

J. F. Yates, Dr. E. G. Edwards, Mr. W. G. Darvell, Mr. R. Myers, Mr. G. B. Bennett, and other Heads of Departments for suggestions and comments relating to their own subjects. My sincere thanks are due to Mr. W. J. Hodgkiss, the Registrar, for his help in the onerous work of checking the proofs. I am very grateful to my secretary, Miss M. Ward, for all the extra work she has so readily undertaken in connection with this book.

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P. F. R. Venables

June, *1955*

NOTE TO THE SECOND IMPRESSION

Remarkable changes, some foreseen and some almost past hoping for, have come about since this book was published in November, 1955. First came the disclosures made by Sir Winston Churchill in his Woodford speech on 5th December, 1955, followed by the Prime Minister's speech at Bradford on 18th January, 1956 (§ I; see footnote). Among a continuing spate of publications, the Report by Nicholas DeWitt on *Soviet Professional Manpower* has been outstanding in its impact.* Then the Government White Paper on *Technical Education* was published in February, 1956. This marked a new phase with definite proposals backed by a promised allocation of £80 millions for new buildings and £17 millions for equipment for technical colleges in England, Wales and Scotland on a five year plan (§§ 93, 152).

Briefly the main proposals of the White Paper were as follows: the output of 9,500 students from advanced courses to be raised to about 15,000 per annum (§ 56); the number of part-time day students released from industry, namely, 355,000 in 1954-5, to be doubled (§ 85): a recent report of the National Advisory Council on sandwich courses, recommending them especially to professional

Paragraph references in this Note are to the White Paper on Technical Education Cmd. 9,703, H.M.S.O.; page references are to this book.

* Published by the National Science Foundation. Washington, D.C.

level (§ 59; pp. 86, 576), was fully endorsed; State Scholarships awarded on the General Certificate Examination (Advanced Level) would be tenable in such courses (§ 62; p. 527), while the number of Technical State Scholarships would be increased (§ 61); particular attention must be given to the further education of girls (§§ 87-92; pp. 466-7); many more teachers will be required, and the Government hoped that industry would be more ready to release yet more of its employees for part-time teaching during the day (§ 101; p. 580).

The White Paper listed 24 colleges in receipt of 75% grant under Circular 255 (§ 68; p. 607), and stated that 'The Government now wish to see the proportion of advanced work at these colleges vigorously increased, *so that as many of them as possible* may develop speedily into colleges and advanced technology' (§ 69; author's italics). While the Government did not wish to see these colleges withdrawn from the local authorities, it stipulated one essential condition of effective consultation and inter-authority arrangements to meet students' needs (§ 71). The White Paper contained general observations on the required academic independence, governance and finance, staffing, equipment, accommodation and amenities of the proposed colleges of advanced technology.

In May, 1956, the National Council for Technological Awards (p. 578) issued its Memorandum on the recognition of courses in Technical Colleges leading to the Diploma in Technology. Briefly the provisions include a first award of Diploma in Technology, denoted by Dip.Tech.(Eng.) for engineering, and Dip.Tech., only, for other technologies; two honours classes, first and second, and the latter to be the level of a second class honours degree of a British University; the award to be made only on a broadly devised 3-year full-time or 4-year sandwich course, both with related industrial experience; the requirements of staffing, equipment, accommodation and amenities being very similar to those indicated in the White Paper.

The next major event was the publication on 12th June, 1956, of the proposals for salaries under the Burnham Technical Report to be applicable as from 1st October, 1956. In general, these make good the defects of the 1954 Report and reduce the inbalance between technical education and industry and other professions (p. 580). Furthermore, special provisions have been included relating to Designated Colleges of Advanced Technology, in the addition of a new senior post of Readership, and of a Grade VI Head of Department with a salary scale comparable to that of a University professor, and in freeing the Establishment of Posts from the application of Appendix VI of the 1954 Report.

Close upon the Burnham proposals came the culminating events of the House of Commons debate on technical education on 21st June, 1956, and the simultaneous issue of Circular 305 on the Organisation of Technical Colleges. A four tier system is envisaged, namely, Local Colleges, Area Colleges, Regional Colleges (all the foregoing substantially as at present though with some clarification and expansion) and, at the apex, the Colleges of Advanced Technology. In the debate, the Minister stated he proposed to designate the following as colleges of advanced technology

College of Technology, Birmingham
Bradford Technical College
Cardiff College of Technology and Commerce
Loughborough College of Technology
Royal Technical College, Salford
London, Battersea Polytechnic
    Chelsea Polytechnic
    Northampton Polytechnic.

These eight were provisional as the Minister had still to satisfy himself that in so far as they did not already fulfil the necessary conditions (as laid down in Circular 305), they would be able to do so in the near future. Bristol College of Technology had been added to the list of Regional Colleges and would be considered for graduation to advanced status subsequently on certain conditions, including the full support of industry. After consultation between the local authorities concerned and industry through the Northern Advisory Council, a college would be designated in the north east (comprising the Tyneside and Teeside areas). The phrase from the White Paper, emphasised above in italics, now comes to a probable firm total of ten out of some 25 Regional Colleges (p. 607). Though detailed criticisms remain, it does appear that at last, some eleven years after the Percy Committee Report (p. 468), the stage is set for a great advance in technical education at all levels. We now seem to have the basis and the promise of a system of higher technological education truly complementary to that of the universities. The true assessment of this will, however, only be seen in relation to the University Grants Committee's Report and proposals for the next quinquennium.

Opportunity has been taken in this second impression to make certain minor corrections, and I naturally wish to thank those who have kindly helped in this respect.

P. F. R. Venables

College of Technology, Birmingham

25th June, 1956

CONTENTS

Chapter Page

Preface v

Note to Second Impression viii

I Introduction 1

II Character and Range of Institutions . . . 31

III General Working Arrangements and Courses (mostly full-time) 69

IV General Working Arrangements and Courses (mainly part-time) 104

V Partnerships in Technical Education . . . 129

VI Industry and Education 172

VII Selection and Placement in Technical Education . 219

VIII Engineering. By C. L. Old, B.Sc.(Eng.), M.Sc.Tech., M.Inst.C.E., M.I.Mech.E., Principal, Wolverhampton and Staffordshire Technical College . 245

IX Building. By D. A. G. Reid, B.Sc.(Eng.), A.M.I.C.E., A.M.I.Struct.E., Principal, L.C.C. Brixton School of Building 281

X Art. By K. Holmes, O.B.E., A.R.C.A., M.S.I.A., Hon.F.I.B.D., Principal, Leicester College of Art 305

XI Women in Further Education. By Miss E. Hollings, B.A.(Admin.), Principal, The Domestic and Trades College, Manchester 332

XII Commerce. By E. Thompson, M.A., B.Sc., Ph.D., Principal, Scottish College of Commerce. . 361

XIII Other Technologies and Crafts 391

XIV The Sciences and Other Subjects 423

XV Higher Technological Education 446

XVI Freedom and Governance, Finance and Administration 481

XVII Students' Needs and Problems 509

XVIII Staffing and Administration of Colleges . . 531

Chapter *Page*
XIX Buildings and Equipment 550
XX Conclusion: Outstanding Problems and Present Opportunities 565

Appendix: Colleges, Organisations, Statistics, etc. 587
Subject Index 627
Name Index 641

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CHAPTER I

INTRODUCTION

SINCE the ending of the war in 1945–6, there has been a prolonged public controversy over technical education which, though it may have shed more heat than light on its problems, has at least been a welcome sign that technical education can no longer be ignored. The controversy stems from conflicting causes, some external to technical education, while some have arisen internally from its great expansion during and since the war, and yet others are deep seated in the history of education in this country.

Foremost among the external causes has been a growing public awareness of the great changes, both in quality and range, which have taken place in technical education. During the War it became evident that technical education was essential to survival, and the same has been seen to be true in the post-war period, though the issues are seemingly less urgent and certainly are more confused. They have naturally led to greater demands for finance and resources, partly to redress the admitted neglect of former times but also to meet the challenge of this post-war world in which scientific and technological advances are of a critical importance inconceivable in pre-war years.

These demands could not have been made at a more difficult time due, on the one hand, to the extreme national impoverishment arising from the war and, on the other, to other competing demands arising from much the same causes as those which affected technical education itself. For example, it is one of the strangest ironies that modern war should put such a premium on education; an illiterate soldier is a liability, a technically competent one an indispensable asset. For purposes of morale, as well as of general organisation in a democracy at war, educational standards must not only be maintained but raised; by the same token the personal and public, the industrial and governmental needs of peacetime demand better education and facilities for it. Quite apart from the rising birthrate, the requirement of better schooling, in more schools and with more teachers would be inescapable. No one engaged in technical education could or would wish to deny that progress can be made only on a good foundation of general education, but it is a painful fact that the necessity for providing for the schools has strictly limited the expansion of technical education and has certainly made the controversy more acute.

The grave economic and physical consequences of the war have combined to prevent the means of their removal. It became necessary to train more builders, craftsmen and technicians than ever in fewer, or much less suitable, buildings than before and with only the remotest prospect of adequate means being provided. Again, the estimated need to double the number of trained scientists and to increase the proportion of technologists strained actual and potential resources, not least in staffing, to the utmost. All combined to raise the most acute problems in technical education: the relative functions and responsibilities of the universities and the major technical colleges in training scientists and technologists and the allocation of appropriate resources; the growing regional organisation of technical education and the consequent differentiation of technical colleges as local colleges of further education, area colleges and major colleges of technology; the concentration of higher courses in fewer colleges and their possible encouragement with higher rates of grant and by special academic awards. Few educational controversies have been so prolonged or intense or have generated so much writing and reporting by all and sundry; yet, as will be seen, action has lagged far behind. Though infuriating to the intense enthusiast, nevertheless, this is understandable and may even be justifiable, for the issues are complex, the right path difficult to discern and to make progress fast in a wrong direction can hardly be wise. In all this, too, there has rightly been made a close study of technical education in other countries, notably the United States, especially by visiting groups of experts [1]. Nevertheless, even here a hastily borrowed remedy may well be worse than the necessarily deferred result of a prolonged analysis and consideration of our own problems.

It is well to consider the causes of controversy in the contemporary scene, if only to realise that they are for the most part inescapable, but it would be unwise and unfair if we allowed the heat too often generated to expand the controversy out of all proportion. Leading representatives of industry have paid tribute to the importance of technical education and given great attention to its problems. The professional institutions have shown a lively concern for its progressive development and standards and valid criticisms and valuable suggestions have come from many quarters. Though the divisions go deep, much is now generally agreed, and the time is now ripe for a detailed account of technical education. Moreover, the changes in the number and size of institutions, in the number, diversity, range and quality of courses, have been so very great that an up-to-date record is urgently necessary. It is not solely or even primarily a question of size, and the consequent effect on internal college organisation is but one aspect of the changed expanded function of technical education and its relation to further education as a whole, as compared with pre-war days [2].

Any such account of technical education to-day must begin with the Education Act, 1944. When the Bill was drafted it required in Section 39 under Further Education, that every local education authority should secure the provision of:

> '(*b*) full-time and part-time education in technical, commercial and art subjects for persons over compulsory school age.'

No such reference to technical, commercial and art subjects or to technical education is to be found in the 1944 Act itself [3]. The exclusion of such terms was due not least to the difficulty of their definition and the possible result that other courses or subjects may not come under grant regulations, with its echoes of the Cockerton Judgment [4]. 'It passes the wit of man so far as I know', said T. H. Huxley, 'to give a legal definition of technical education. If you expect to have an Act of Parliament with a definition which shall include all that ought to be included, and exclude all that ought to be excluded, I think you will have to wait a very long time' [43].

Previously, local education authorities had had the power to provide technical education as part of higher education, but had exercised this power in varying degrees. The 1944 Act laid upon them for the first time a statutory duty in respect of Further Education, which includes technical education, in the following section:

FURTHER EDUCATION

41. Subject as hereinafter provided, it shall be the duty of every local education authority to secure the provision for their area of adequate facilities for further education, that is to say:

a. full-time and part-time education for persons over compulsory school age; and *b.* leisure-time occupation, in such organised cultural training and recreative activities as are suited to their requirements, for any persons over compulsory school age who are able and willing to profit by the facilities provided for that purpose;

Provided that the provisions of this Section shall not empower or require local education authorities to secure the provision of facilities for further education otherwise than in accordance with schemes of further education or at County Colleges.'

The whole field of further education contains a great amount of voluntary activity and the work of bodies other than the local authorities and the Ministry of Education. The Act does not require the local authority itself to provide everything in further education in its area, but 'to secure provision'; this allows of arrangements between authorities of regional schemes for advanced courses, and co-operation with and support of many voluntary bodies, for example, the Workers' Educational Association [5].

Further education is a very large field of activity of quite extraordinary diversity. This description applies almost equally to the greater part of it which is the most direct concern of the Local Education Authorities and of the Ministry of Education (hereinafter known as the L.E.As. and the Ministry respectively) [44]. This may readily be seen by perusing the fascinating and colourful publications of many L.E.As. such as the London County Council publication *Floodlight* or the Manchester pamphlet *Opportunity.* They portray a wealth of activity and public service of a richness and diversity that is seldom acknowledged by the general public. The sheer volume of work is impressive as may be seen from Table 1 [6].

TABLE 1*

FURTHER EDUCATION 1952–3—ALL ESTABLISHMENTS

Type of Student	Number of Students who Attended at Any Time During the Educational Year			
	ENGLAND	WALES	SCOTLAND	TOTAL
Full-time Courses	55,000	2,182	10,361	67,543
Part-time Day Courses	335,001	18,048	22,817	375,866
Evening Courses	1,699,260	129,925	201,817	2,031,002
TOTAL	2,089,261	150,155	234,995	2,474,411

When using statistics one should remember the aphorism that 'a statistician is one who proceeds in a straight line graph from an unverifiable assumption to a foregone conclusion', and interpret them with care. Such a summary table probably hides much more than it reveals but some observations may be made with firmness. The reasons why students undertake further education are many and various, including the economic and also the satisfaction of personal ambitions and interests; but the figures are nevertheless a testimony to the work of the secondary schools in stimulating a desire for further education largely on a voluntary basis (a point which those engaged in Adult Education should not overlook). The development of secondary education, and the betterment of conditions in the schools, especially in reduced size of classes [7], will undoubtedly produce a still greater interest in further education.

---

* Session 1954–55 England: Full-time 60,629; Part-time Day 381,376; Evening 1,775,723. Wales: Full-time 2,520; Part-time Day 20,863; Evening 125,740.

Reckoned in the relative numbers of students, further education seems to depend far too heavily upon evening attendance for there are some thirty-six evening students for six part-time day students and each full-time student. A comparison of the proportion of each age group in attendance would not be valid for the later age groups, for adults would not be expected to attend to anything like the same extent as younger students in daytime classes. Nevertheless, it is broadly true that too many attend evening classes who could and should attend daytime classes (p. 119), but it is encouraging to note the change from pre-war days, shown in Table 2 [8].

Such increases should not lead to complacency for reasons examined later (p. 198), especially when there has been a drop of 227,800 in evening classes due mainly to increased fees charged to students in non-vocational classes. The absolute figures are not very encouraging when we compare them with other countries, especially the United States [9]. There, for example, some 36% of the 18-year age group is in full-time education, 20% of the 19-year group, 12% for the 20 years old, and even 9% of those aged 21 years. In England and Wales the figures for full-time are 7·5%, 6·5%, 5·5% and 5% respectively. While there is much variation between the States, and there is little part-time day work compared with England and Wales, yet the total educational comparison in the foregoing figures is thought provoking and is not easily discounted.

Something of the diversity and range of work can be gauged from the Ministry's 1953 Report, especially Tables 43 to 50, which show the classification of full-time and part-time day courses in relation to the intended or actual occupations, and of general subjects taken by them. Table 11 in Chapter IV (p. 117) shows the main subdivisions of the Ministry's Table 49 relating to evening classes.

TABLE 2

INCREASE OF ENROLMENTS SINCE 1937–9
FURTHER EDUCATION
(England and Wales)

	Number of Students		
	1937–8	1952–3	Increase*
Full-time Courses	12,712	57,182	4·46
Part-time Day Courses	49,462	353,049	7·14
Evening Courses	1,114,598	1,829,185	1·64
TOTAL (England and Wales)	1,176,772	2,239,416	1·90

The expansion since 1937–9 is shown graphically in Diagram 1.

These figures are for England and Wales only as comparable statistics for Scotland are not available, which is regrettable, for many interesting comparisons are meanwhile impossible.

The classification in Table 11, Chapter IV, is a broad one for it is virtually impossible to distinguish between further education which is of direct use to the individual as an economic unit or to the industry in which he is employed, and further education which could be classified as cultural or recreational. The Sections 'B' and 'C' are most clearly defined, but Section 'A' comprising 'General Subjects' is nevertheless strongly vocational in purpose and even in content. Group 2 contains languages required for commercial and other vocational purposes, Group 5 includes practical mathematics while most of the sciences are studied either as main subjects or as essential ancillaries to the achievement of vocational competence, for example, engineering or building science. Even a high proportion of the work in English is vocational in nature in preparation for advanced courses, for professional preliminary examinations and for increased competence at work.

Probably altogether about 70% or 80% of the 100,000,000 total number of student hours in these classes might be regarded as vocational and of direct usefulness to the student as an employee [5*a*].

Though Table 11 deals only with evening classes, the 24 group headings give a good picture of the general range of further and technical education. There are of course marked differences in work done between full-time day, part-time day and evening courses; for example, over 20 different languages are taught in the evenings which exceeds the daytime provision. The purpose here is to emphasise the rich diversity of work in technical education and to combat the all too prevalent

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* Ratios by 1954-5 Session: Full-time 4·96, Part-time Day 8·13, Evening 1·71.

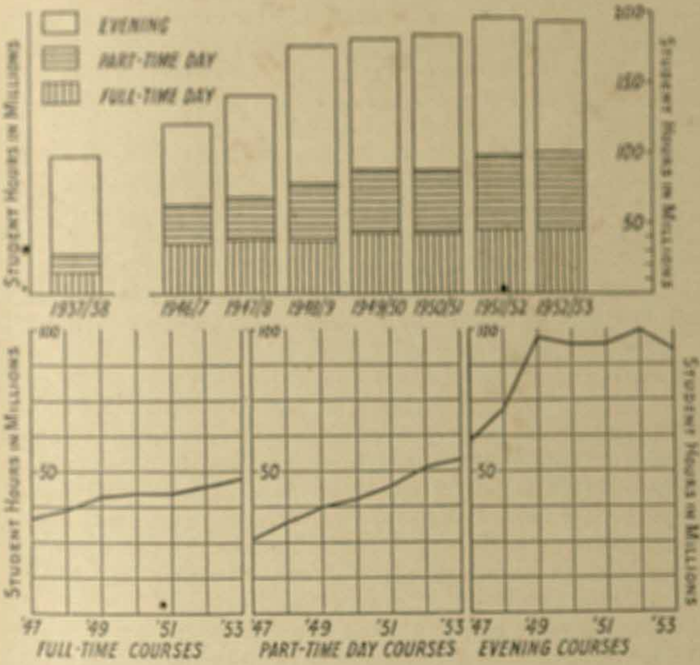

DIAGRAM 1. DEVELOPMENT OF FURTHER EDUCATION from 1937–8 to 1952–3 inclusive. All establishments England and Wales *Source: Ministry of Education Reports for the years 1947 to 1953* (*H.M.S.O.*)

talk of the work of technical colleges as 'mere-narrow-technical-specialisation' in contrast to the 'broad-liberal-education' (the phrases are always hyphenated in effect) of which certain institutions are so often claimed to be the sole repository.

The interest and significance of the 24 group headings is much increased by a perusal of the 359 subjects and sub-headings which are listed under them, as may be seen from the Ministry's Table 49, and similarly for Art in Table 50 (both, 1953 Report). Another way of realising the unusual diversity of further education is to observe the unexpected juxtaposition of subjects in the alphabetical index of many a prospectus.

For example—Accounting, Administration, Advertisement Design, Aerodynamics, Aesthetics, Agriculture, Air Transport, Anatomy, Animal Drawing, Applied Optics, Aquarists, Arabic [10]; or again, from a technical college prospectus, Keep Fit, Knitting, Lace Making, Landscape Painting, Latin, Laundry Work, Law and Custom of the Constitution; or go again to alphabetical extremes—Upholstery, Vacuum Technology, Valuations, Voice Production, Waiting, Watch and Clock Making, Weaving, Welding Structures, Welsh, Wig and Postiche Dressing, Woodcutting Machinist's Work, Writer's Craft, X-rays, Zoology [11]. Even the contrapuntal treatment, that subjects and courses range 'from Greek Dancing to Greek Literature, from Home Carpentry to Astronomy, from Boxing to Metaphysics' [12] fails valiantly to convey the great diversity and unexpectedness of technical education. A close scrutiny of such publications is better, but only visits to such institutions, especially on some such public occasion as an Open Day, can bring the lists to life.

Against the general background of further education as a whole we now look more closely at technical education itself. As will readily be guessed from the comments on the classifications in Table 11, the problem of definition and delineation of the field of technical education is a difficult one. This arises in part from the history of technical education, from the nature of subjects and activities undertaken and from the purposes and interests of the students. It might be simpler first to think primarily in terms of institutions.

After the manner of defining intelligence as 'that which intelligence tests test' we may define (for our present purposes only) technical education as the education carried on in technical institutions. But this is to imply a uniformity which does not in fact exist. The work of technical institutions is not confined to technical or vocational subjects, and there is a tendency to widen their scope in many instances so that they are acting more and more as 'colleges of further education'. There are 592 further education establishments dealing with technical, art and commercial education (omitting evening institutes) and their heterogeneity and diversity are shown at first glance from their titles:

TABLE 3

TYPES OF FURTHER EDUCATION ESTABLISHMENTS

	Number
Polytechnics	12
Technical Colleges	150
Technical Institutes	90
Colleges of Technology, Art and Commerce	20
Colleges of Further Education	39
Colleges and Schools of Commerce	24
Colleges of Art	32
Schools of Art and Crafts, etc.	135
Miscellaneous	90
	592

The Miscellaneous group defies sub-classification, varying as it does from a National College to a Literary Institute, from a College of Building to another of Domestic and Catering Trades, and from Boot and Shoe Manufacture to Printing and Graphic Arts.

There is no such thing as an average or typical 'further education establishment', or even—to choose a narrower field, a typical technical college. Their names betray their varied origins as well as their functions as, for example, technical institute, polytechnic, trades school, technical college, college of technology. The evolution of many an institution is recorded in such a succession of names as Industrial Road Evening School, Smogtown Technical School, Ashville Technical Institute and Coalport Technical College, until finally the appellation 'Technical' is dropped in fully fledged Millborough College, a collegiate institution at least in name. Others became known as the Municipal College, the college which exists for the further education of the citizens of the borough, while 39 others, especially new post-war colleges, have reflected the 1944 Act in being styled as Colleges of Further Education.

The greatly increased use of the description 'college' is the result partly of a need to be distinguished from the Secondary Technical School (p. 94), partly because of a natural desire for social prestige, but also because it does cover a widening function. From being initially perhaps little more than congeries of classes many institutions have, over the years, and especially since the war despite lack of amenities, grown into real communities with a lively sense of corporate life [13, 14], and justify the name of college. In some cases the appellation may be more a mark of aspiration, while others do not adopt it for historical causes or quite justifiable reasons of sentiment. Thus the major polytechnics are most unlikely to change their names, and perhaps much the same influences keep students referring, almost affectionately, to 'the Tech.' when they might respectfully refer to 'the College'. (Incidentally, many an applicant for a Technical State Scholarship has had difficulty in recognising 'the Tech.' as an 'Establishment for Further Education'.)

Again, after the manner of defining a Public School as one whose Headmaster is a member of the Headmasters' Conference, technical education might be defined as the work of an institution whose Principal is a member of the Association of Principals of Technical Institutions (A.P.T.I.) (p. 164). The main groups of institutions are shown in Table 4.

TABLE 4

Institutions with the Principal in membership of the Association of the Principals of Technical Institutions

	Number
Polytechnics	12
Technical Colleges	129
Technical Institutes	11
Colleges of Technology, Art and Commerce	20
Colleges of Commerce	12
Colleges of Further Education	16
Miscellaneous	31
TOTAL	231

The Principals' Association sets certain standards as to quality and volume of work for admission to membership and a comparison of Tables 3 and 4 shows that, for comparable groups, the biggest reduction in members is with technical institutes (11 out of 90), colleges of further education (16 out of 39) and miscellaneous (31 out of 90). In both Tables 3 and 4, the totals and the analyses are necessarily approximate, being influenced by changes in membership for various causes (e.g. Some National Colleges have come into membership and are included under Miscellaneous): but the field is narrowed to a significant degree.

The Association of Technical Institutions (A.T.I.) is not a professional association and has Governor representatives in membership (p. 163). Its purpose is different and its membership is 242 institutions, including the National Colleges. Practically all the institutions in A.P.T.I. are in A.T.I. also, and together they total 258 institutions.

Included in Table 3 are 32 colleges and 135 schools of arts and crafts (Chapter X) and these also vary very greatly from important regional colleges of art to very small isolated schools of art. There is no professional association for Principals of such art institutions comparable to A.P.T.I. but the analogue to A.T.I. is the much younger Association of Art Institutions (A.A.I.). The situation is complicated (p. 166) and there are only 80 institutions in A.A.I. of which five are schools of art in technical colleges. To this nett 75 should be added another about 20 equivalent art institutions. If we regard, for our immediate study, the scope of technical education in England and Wales to be concerned with the work of those institutions in membership of A.P.T.I., A.T.I. and A.A.I., there are about 355 institutions within our purview. Large though this number is, it excludes 237 establishments of further education, a very much larger number of evening institutes, those institutes with preparatory technical courses, secondary technical schools, day continuation schools and other precursors to the county colleges of the 1944 Act. Nevertheless, important though these means of providing technical education are to-day, they cannot here be given as full attention as could be desired. The great bulk of technical education is in fact carried on in those institutions in membership of A.T.I., A.P.T.I. and A.A.I. as shown by Table 5.

TABLE 5

VOLUME OF WORK IN TECHNICAL, ART AND COMMERCE INSTITUTIONS

(England and Wales 1952–3)

	NUMBER OF STUDENTS				STUDENT HOURS	
Institution in Membership of	Full-time	Part-time Day	Evening	Total		% of National Total
A.T.I. and A.P.T.I.	38,674	248,493	517,946	805,113	102,406,225	69·05
A.T.I. only	1,510	18,911	35,726	56,147	5,816,859	3·92
A.A.I.	8,793	19,321	59,902	88,016	14,699,025	9·88
TOTAL	48,977	286,725	613,574	949,276	122,922,109	82·85
% OF NATIONAL TOTAL	86·48	80·10	77·41	78·65	82·85	—
FURTHER EDUCATION ESTABLISHMENTS NATIONAL TOTAL (exc. Evening Insts.)	56,481	358,049	792,658	1,207,188	151,750,514	100

There is a small group of institutions which warrant special consideration for they provide technical education in response to national needs, drawing students from all over the country. These are the National Colleges (Appendix, p. 603) which are not the responsibility of the local authority, but have their own corporate governing bodies. They are sustained financially by a direct grant from the Ministry of Education and both industry and Local Authorities contribute financially in some cases. This group of institutions embraces important post-war developments in higher technology and their significance is discussed in Chapters XIII, XV and XVI. In addition to the foregoing, some works schools are direct grant establishments but these are local in character and function.

Again, this definition of the field of technical education might appear to exclude two major sectors. The first is that of the universities insofar as they are concerned with professional and technical training and with industry's requirements in many ways. But of course the question of the relative functions and sphere of work of the universities, the major technical colleges and the national colleges is a problem of major importance. Here again is a problem of definition, of distinguishing between technical education and technological education, and certainly if this could be achieved administratively as well as verbally things would be much simpler. Technological education is concerned with the training of applied scientists and designers studying for the professions and for management in industry and commerce. Unfortunately the term 'technical education' is applied to the work of technical institutions as a whole and is also restricted to particular types of courses for technicians and craftsmen and it is difficult to see how it could be otherwise. Confusion at once arises because some technical institutions provide both technical and technological education, and do so in widely differing proportions.

British universities are a well-defined group of institutions, established by Royal Charter, and there are but twenty of them [15]. In England and Wales there are 15 universities and three university colleges, in Scotland four universities, in Wales one university (Appendix, pp. 605–6). John Citizen has a fairly clear idea of what a university is, and is largely untroubled by the higher flights of philosophic criticism regarding its purpose and function. On the other hand there are those steeped in the philosophy of 'the university', who have followed its fascinating development, for example, from Newman's *Idea of a University* and Rashdall's *Mediaeval Universities* to Bruce Truscot's *Redbrick University*; from Flexner's *Universities* and Ortega y Gasset's *The Mission of a University* to Sir Walter Moberly's *The Crisis in The University* and *The University of Utopia* by Dr. R. M. Hutchins [16], not to mention the lively discussions in the pages of the *Universities Quarterly* [17]. But they all have a conception of 'the university' with an acceptance sufficiently wide as to bear a sustained and profitable discussion of its aims and purposes. The notable contributions of the late Professor Allison Peers as 'Bruce Truscot' undoubtedly stem from this underlying acceptance, and the liveliness of his treatment of the problems of *Redbrick University* is due to the working out of that conception within the contemporary industrial civilisation.

By contrast both technical education and technical colleges are heterogeneous to an extreme degree. Not only does this prevent easy description and classification but it makes the wide application of such a restricted definition as that given above misleading and inapplicable. Moreover the wish may well be father to the thought, and the identification of technical education, as defined above, as the sole work of the technical colleges would require their abandonment of technological courses. Another aspect of this problem of definition and diversity of work is in the controversy about the possible granting of degrees by technical colleges. When there are 257 technical institutions (excluding art) as compared with 16 universities and three university colleges in England and Wales, when these technical institutions are so varied in size and scope by comparison with the universities, no wonder the proposal to grant degrees (seemingly without limit) raised acute apprehensions and formidable resistance. These and related matters are discussed in Chapter XV, but the title and subject of this book 'Technical Education' are taken to include technological studies, unless the context warrants otherwise. Such a case is where a strict comparison has to be made between the work of the universities and major technical institutions in the sphere of advanced technology. There, in the unfortunate absence of a suitable alternative term 'technical education' must be contrasted with technological education [18].

The second major sector of further education which would be excluded by a strict definition in terms of membership of the three Associations is agricultural education. As agriculture is of such great importance to the well-being and economic stability of this country we would not wish even to appear to minimise its significance. But to deal with it in the earlier chapters, alongside technical education as defined, would only cause confusion. The field to be dealt with is already wide enough to be embarrassing, while certain major differences—between the largely urban industrial and commercial occupations and the arts of agriculture (with the increasing modicum of science and technology) and the very different conditions under which they are pursued—cannot be overlooked. For this reason agricultural education is very briefly summarised in Chapter XIII.

The heterogeneous work and varying character of technical institutions stem from their deep roots in the life and work of the community. Their history is a complex interweaving of many factors and influences as, for example, the following: the desire of men and women for education to make good their lack of schooling, the satisfaction of their personal ambitions to get on in life through the attainment of skills and mastery of knowledge; the increasing demands which followed in the wake of scientific discoveries; the slowly realised need to place traditional empirical practices on a scientific foundation and the need to anticipate technological applications potential in pure science; and latterly, a desire to solve or at least to some of the human problems arising in the management of industry and commerce and, by attention to good design, to generate some essential conditions of a pleasanter happier world.

As has already been noted by H. C. Dent, the social history of technical education is a fascinating field of study which has been too long neglected [19]. Some valuable outlines exist [20] but the time is surely ripe for a scholarly study by a competent historian. All that could be attempted here, not only for lack of space, would be yet another brief outline, and it could add nothing whatever to those accounts already cited. Yet the historical aspect cannot be ignored and the clue for a possible mode of treating it may lie in the surprising fact that no comprehensive study exists at all. In view of the economic importance and the general social significance of technical education, which is now widely admitted, the absence of a detached authoritative study surely reflects the long continued low status and lack of prestige of technical education in this country. It would be poor apologetics and worse history to indulge in special pleading for technical education along these lines, yet it is curious that it should be so in a commercial and industrial nation. It is interesting to examine what must be the cumulative effect of many far-reaching causes; in these days of increased confidence in a brighter future for technical education it should be possible to discuss them without rancour.

Technical education began in classes formed to meet the needs and aspirations of the under-privileged, the lower social classes, as witness the growth of the Mechanics Institutes from 1823 onwards, from the various classes and societies which preceded them [21]. Admirable as were the aims of their founders, the Institutes nevertheless contained the seeds of their own decay in that the workmen who attended them were so wanting in general education as to be unable to profit from the instruction offered, and so to feel that they were not wanted. Add to this the inappropriateness of teaching methods and the lack of competent teachers of relevant experience and background, and it is perhaps not surprising (in retrospect) that their own educational work declined rapidly from about 1848. But their wider educational influence remained to ease the way for later developments.

When this later expansion took place it was of course once more with the same social classes, as witness, for example, the devoted work of Quintin Hogg from about 1871 onwards in providing educational facilities for working lads between 16 and 21. So throughout their existence the polytechnics and the technical institutions generally have had as an integral part of their work this remedial task of making good former educational deficiencies. With the expansion of the system of education, especially with the establishment of the elementary schools in 1870 and the development of maintained secondary grammar schools since 1902, the proportion of this work has diminished. In recent years the major colleges have increasingly shed this work to area and local colleges, but it is unlikely to vanish from technical education as a whole while about 83% leave school at 15 years of age and these mostly from schools with classes still disgracefully large. Moreover, whatever form secondary education may take in the future and no matter how much research is done on selection methods, human nature being what it is, there will still be misfits and those who do not develop till later. In this way technical colleges have acted as a safety valve in the educational system and have prevented the frustration of very many people of real ability and will continue to do so [22, 23]. But it cannot be said that this invaluable work has added much to their reputation: insofar as it has been realised to have been done it has often been used as an argument that their work is of a low standard incompatible with advanced technological education.

Technical education has always been strongly rooted, too, in the occupational needs of those engaged in skilled trades such as building and engineering. Though these are vital to an industrial country they have rarely been held in high esteem in the community at large. The growth of technical education has been paralleled by the rise of the various professions and the establishment of professional institutions and these have all influenced each other to their mutual advantage. Standards of excellence were early secured for the skilled trades (we need not go back as far as the mediaeval guilds) by the establishment, for example in 1880, of the City and Guilds of London Institute (p. 150), and that of the Regional Examining Unions (p. 146), e.g. of the Union of Lancashire and Cheshire Institutes in 1839. Nevertheless their excellent and progressive work has not been sufficient to offset the lower social status of such trades and classes. This presents many technical colleges with a continuing problem because of the resulting strong pressure away from these courses into the professional courses and especially since the start of the National Certificate System in 1921 (Chapter V). Many unsuitable students find their way into professional or professional preliminary courses who would fare better in craft courses. The pressure comes from parents and employers and the student is so subject to their influence that he will face repeated failures rather than transfer to a trade course. This is an important matter requiring further discussion, especially from the standpoint of selection methods (Chapter VII); here we simply note its importance as a social symptom inseparably linked with the status of technical education.

Among the most important educational developments since 1900, if not the pre-eminent one, has been the growth of the secondary grammar schools and the civic universities. Far from being unconnected their growth has been mutually stimulating; this has also been true, but with a different emphasis, of the grammar schools and the ancient universities from which so many of their teachers and those of the civic universities come. In this context too the influence of the public schools is important since the offspring of the managers of industry and commerce have gone increasingly to them [24]. The thread of consequences of the derivation of teaching staff and of this mutual interaction is still strongly woven into the modern pattern of education. The devotion of the ancient universities to a classical tradition made them unreceptive, even hostile, to those seeking a scientific education. The battle for science was won in due time [21, 25] not least because of the competition of the civic universities, whose rapid rise was largely due to their meeting this urgent need [26] but the resistance has shown itself again, at a second remove and perhaps on sounder grounds, in the recent controversy about introducing or increasing the proportion of technological studies in the universities [27].

The interaction of the ancient universities ('Oxbridge') and the new civic universities ('Redbrick') can be left to 'Bruce Truscot' and his successors [16], but we must pay attention to one aspect of the values based on a classical education disseminated by teachers from Oxbridge. It is unquestionably true that 'This Platonic ideal has rendered imperishable service to European civilisation. It has encouraged art, it has fostered that spirit of disinterested curiosity which is the origin of science, it has maintained the dignity of mind in the face of material force, a dignity which claims freedom of thought' [28]. In view of the truth of that tribute nothing must be taken in what follows as minimising the importance of such an education, or as betraying an unawareness that the acute modern problem is how to relate it to a scientific education, as witness Dr. Robert Birley's notable address *Greek or Science—or Both?* [29].

In his examination of 'Greek Influences on English Life and Thought' Sir Ernest Barker is naturally concerned to trace influences which are of enduring significance, the subtle and often unacknowledged influences and values which underlie our present civilisation. In making his analysis and in paying his rightful tribute to our Greek heritage, he speaks of the 'ancient danger which has vexed the progress of human thought. This is the danger of making the Greek heritage the absolute canon of truth and taste, and of imposing it as a yoke on man's living and growing mind' [30]. Not for the first time did the followers of a philosophy require positive acceptance of its ideas in a rigid form and to a degree undreamt of by its founders—the followers of men of such dissimilar thought and period as Luther and Marx exemplify this. But if the positive requirements become so powerful, the unacknowledged unspoken influences were no less powerful. Of these perhaps the most important was the attitude to work, especially manual work, which was not the lot of the freemen but the burden of the numerically much larger slave population. The indignity of work has remained, for though work may have had its better periods as in the mediaeval guilds, it has never become part of the traditional conception of a 'gentleman'. In his essay on *The Education of the English Gentleman in the Sixteenth Century*, Sir Ernest Barker quotes Sir Thomas Smith in his *De Republica Anglorum* (published after his death, in 1583) as saying 'Whosoever studieth the laws of the realm, who studieth in the universities, who professeth liberal sciences and to be short, who can live idly and without manual labour and will bear the port charge and countenance of a gentleman, he . . . shall be called a gentleman' [31]. It is true that the conception of gentleman widened to include those who showed gentlemanly qualities to such an extent that a proper gentleman need not necessarily be a gentleman born. But if the meaning has widened because these qualities were found outside the hereditary class, the reverse change of including among these qualities that of a high capacity for and competence in work did not follow at all, at least not until very recent times. There is the danger of making too much of this point, but it is taken only as showing the general attitude and outlook of the ruling classes of the times; and this not least because the rising commercial and industrial groups of the industrial revolution began to emulate these established ruling classes.

In showing concern about the far-reaching adverse effects on technical education of the influence of Oxbridge and 'the education of a gentleman' stemming from ancient Greek sources, we may note what A. N. Whitehead had to say in his address on *Technical Education and Its Relation to Science and Literature* [28]. Plato's 'type of culture is the peculiar inspiration of the liberal aristocrat . . . for certain people it is a very good education. It suits their type of mind and the circumstances amid which their life is passed. But more has been claimed for it than this. All education has been judged adequate or defective according to its approximation to this sole type.' How true is that of so many facile judgements passed on technical education! The reader is referred to Whitehead's Address for the way he develops his theme that 'There are three main methods which are required in a national system of education, namely, the literary curriculum, the scientific curriculum, the technical curriculum, but each of these curricula should include the other two', for no selection of quotations can do full justice to the importance of his message. Here we can but note his encouraging statements —'The peculiar merit of a scientific education should be that it bases thought upon first-hand observation; and the corresponding merit of a technical education is that it follows our deep natural instinct to translate thought into manual skill, and manual activity into thought'; and that 'A technical education is not to be conceived as a maimed alternative to the perfect Platonic culture; namely as a defective training unfortunately made necessary by cramped conditions of life.'

The secondary grammar schools are fully seized of the vital importance of their contribution to the universities and it is rightly acclaimed as the chief glory of their achievement since 1902. But they have, unwittingly rather than consciously, made another contribution in that technical education has greatly benefited from their work. This can readily be shown by an analysis of the examination successes of technical college students (p. 224), but it is seldom acknowledged. Perhaps it is unawareness, perhaps it is that a natural concentration on the careers and successes of those former pupils in a familiar academic milieu leads to a lack of interest in those who succeed in a diversity of unfamiliar occupations. But it is rare that the honours lists, whether on honours boards or announced at prize-givings, mention the achievements of former pupils in technical education—a London University

B.Sc. degree (external) perhaps, even an A.R.I.C., but what of the many professional qualifications and Higher National Certificates and Diplomas. Again, too much might be made of a single facet of this problem but the powerfulness of this cumulative social pressure which the schools exert against technical education can hardly be exaggerated. To the classics have been added the sciences as liberal studies, provided or because they exemplify the study of knowledge for its own sake. But it is necessary to go the next step and make technology acceptable and even attractive. The need for this re-orientation of attitude was stressed by Sir Charles Morris in an address to the Headmasters' Conference. 'The trouble is that a study of physics and chemistry does not encourage boys to go into industry. It tends to make them hang around laboratories all their lives. The need is to fire the imagination of boys at school with the exciting possibilities of work in the technological field' [32].

The need is to encourage them to go into industry at various ages and for them and their parents to realise and accept willingly the necessity for an extended education either in the universities or the technical colleges. Both avenues should be stressed and the schools ought to hold the balance more evenly in this respect. In accepting this there need be no fears of arrogant or exclusive claims being made here for the technical colleges, and it is perhaps as well to make this plain early in this book; neither should any hidden sensitiveness be sought or an inferiority complex be fashionably imputed to those who claim a complementary place and function for the technical colleges. The relative importance and significance of the two modes of technological education are discussed in Chapter XV, but here our purpose is to plead for a more urgent sense of the needs of industry and commerce to-day. In view of this urgency, no mutually exclusive attitude makes sense at all and, as is our modest custom, perhaps an outside observer (though with a close knowledge of Britain's economy) may be quoted to point the way to an all-inclusive effort. In an address to the Union of Lancashire and Cheshire Institutes, Dr. Lincoln Gordon, Minister for Economic Affairs at the American Embassy, London, and Chief of the U.S. Foreign Operations Administration to U.K., made this very pertinent comment on current controversy, 'There are, indeed, important differences about the form increased technological training facilities should take—whether through expansion of existing departments of the universities, development of existing technological colleges or establishment of one or several independent institutions along the lines of the Massachusetts Institute of Technology. I venture to suggest that *if all these means were pushed to their furthest practical limits, the resulting expansion would still not surpass the ever-growing needs*' [33] (present writer's italics).

In the growth, maintenance and change of public opinion there are many irrational elements, as every astute politician knows full well. Many emotional reactions carry far beyond their first cause into unrelated fields, as every skilful advertiser knows; the beauty of the blonde is somehow felt to be a guarantee of the scientific accuracy of the manufacture of the product purveyed. Many a parent knows that for his child it is a case of dislike the teacher, hate the subject, quite apart from its intrinsic interest and importance. Technical education, as we know it, has grown up almost entirely since the industrial revolution which began in the late eighteenth century. Hindsight may be futile and it can be offensive but, proud though we may justifiably be of many magnificent achievements since then, we have to admit that our industrial civilisation has had shameful episodes and still retains many an ugly scar. The stigma of the worst aspects of industrial civilisation is thus apt to be attached to technical education which has suffered a surfeit of epithets from those ensconced in ivory towers.

The alleged narrowness of technical training is, in part, the transfer of a rationalised feeling of revulsion against the indisputable narrowness of the lives of workers for many decades in the mills and factories. Though working conditions in industry have greatly changed in this century for the better, despite the impact of mass production, the feeling persists. The professions have high ethical standards and at best a noble appeal to service; at worst industry and commerce have been or have been represented as soul destroying and money-grubbing, and as a ruthless striving for power for ignoble ends. This feeling of contrast persists, despite the greatly changed character of industry which increasingly is coming to realise and fulfil its social purpose and function. 'Unless our technological advances bring us nearer to the possibility of the good life for the many—which is the ultimate meaning of democracy—they have served no significant purpose . . .' [34]. And to Professor R. Peers' assertion we may add another; that unless we can recruit to industry those capable of high ideals and a high regard for their fellow men, industry will achieve no significant purpose and all our lives will be the poorer. Great though the scientific and technological problems of industry may be, they are not so important, nor in the long run so decisive, as the human problems. If this does not form the mainspring of the managerial revolution, all the organisational changes involved, no matter how far-reaching, will be to no purpose. Far from alienating their sympathies the schools must encourage a fair proportion of their pupils and not only the least able, to go into industry by one of the several routes, and all with a zest for adventure and responsibility. Industry now welcomes all levels of ability, and many firms are prepared to select recruits for an appropriate range of jobs (Chapters VI, VII).

From time to time, at official openings of new technical college buildings one has to endure reference to the fact that technical education was greatly stimulated by the grant of 'whiskey money' in the nineties. It may be that technical education began in a good spirit but the proof may well be seen in its erratic progress since then—certainly as far as the provision of buildings and equipment are concerned (Chapter XVIII). To-day, perhaps because of the centenary celebrations of the great Exhibition of 1851 in the form of the Festival of Britain, we are more than usually aware of the importance of that and the later 1862 Exhibition to technical education. Professor Lyon Playfair assisted in organising the earlier exhibitions and was impressed with the great progress made between these two dates by some continental countries, notably France, Prussia, Austria, Belgium and Switzerland. He attributed this to the good systems of industrial education in these countries for employees and managers to which he had drawn attention in 1853 in a pamphlet *Industrial Education on the Continent*. The warnings were thus given early enough but progress was very slow and erratic, desperately so in retrospect because of the severity of economic competition which was to follow, and this despite the establishment of the Department of Science and Art under the Board of Trade in 1853. The Education Department was constituted in 1857 and took over the control of the Science and Art Department from the Board of Trade.

An early result was a system of grants begun in 1859 for science and art classes in the whole country on the basis of payment by results in the Annual Examinations held by the Department. From nine schools and 500 students in 1860 the numbers rose to some 1,455 schools and 57,000 students in 1880. But the numbers and the nature of these entirely evening classes led to the assistance and establishment of 'organised science schools' from 1872 onwards which, from being based initially on the subjects in the Directory of the Science and Art Department, evolved subsequently into the more broadly based Junior Technical Schools. Parallel with their establishment there was the beginning and growth of senior full-time colleges and schools, and, for example, of the City and Guilds of London Institute in 1880 and the endowment of £59,500 for the advancement of technical education in the Metropolis under the City Parochial Charities Act (1883). This led to the establishment or refoundation of the London Polytechnics—Regent Street, the Borough, Battersea, the South Western (Chelsea), the Northern and Northampton Polytechnics; of Birkbeck College, the City of London College, the Goldsmiths' Institute and the People's Palace.

Finally in this period of development came the incongruous windfall already mentioned, of nearly three quarters of a million pounds of 'Whiskey Money'! [35]. This was intended for the compensation of publicans under the Local Taxation (Customs and Excise) Act of 1890, but was devoted to the promotion of technical education 'by one of those illogical twists of the late Victorian conscience which sometimes set on foot such remarkable social movements' [36]. Thus the County and County Borough Councils were told—as a member of the House remarked—'to distil wisdom out of whiskey, genius out of gin and capacity for business out of beer'. Under this stimulus a rapid development of technical education resulted and institutions were established at the following places: Bath, Birkenhead, Birmingham, Blackburn, Bolton, Bradford, Brighton, Bristol, Burnley, Bury, Cardiff, Derby, Dewsbury, Glasgow, Halifax, Huddersfield, Keighley, Leeds, Lincoln, Liverpool, Norwood, London School of Printing, Wandsworth, Manchester, Portsmouth, Preston, Rochdale, St. Helens, Salford, Southampton, Swindon, West Bromwich, West Ham, Westminster and Wolverhampton [37]. From such beginnings many have grown to major institutions of range and scope of work far beyond the imaginings of those early days, but their encouragement has been intermittent and unpredictable. Not for nothing does G. A. N. Lowndes comment at length on the fact that the glow of promise for technical education faded out after the turn of the century so that, for example, the number of first class technical schools built between 1902 and 1918 was scarcely more than ten [38]. The 1914–18 war produced another fitful spurt, but the impulse to establish part-time day education under the Fisher Act petered out except at Rugby [39].

The ardent advocacy of the cause of technical education over several years by Lord Eustace Percy brightened the hopes and raised the expectations of those engaged in this arduous work [40]. In 1929 even he felt that 'there were signs that during the next ten years there would be a national development in technical education as broad and far-reaching as that seen during the last twenty years in secondary education' [41]. The world economic blizzard of 1929–31 blighted all such hopes and it was not until the late thirties that development in technical education was begun again.

A list of new institutions established between the wars would not be a real index of progress, partly because of the limited possibility of entirely new institutions at this stage of development, though the industrial scene had been rapidly changing, especially in the development of new areas, and in modern technologies. Thus it was possible to plan *de novo* and establish new institutions as for example at Dagenham and Walthamstow in 1936–8 (Chapter II). But most of the progress consisted in the adaptation and improvement of old buildings and, more exceptionally, in transference to new or largely new buildings. The general picture was rather one of plans not of practical progress, and of the government scheme of capital expenditure of £12,000,000 agreed by 1939, rather less than £2,000,000 was expended. Fortunate indeed are the institutions whose Authorities were far-seeing enough to build at that time.

In the ensuing years the technical colleges had perforce to carry a vastly increased load of work in all too often inadequate premises and under exacting conditions [42]. Now once again there is hope and expectation in another large building programme despite the straitened times in which we live. But until the major deficiencies have been made good technical education will lack its proper esteem in the eyes of the public. Outmoded, ugly and inefficient buildings still have to be used and the parlous practice of 'Make Do and Mend', in adapting old and often discarded buildings, must still be pursued. Many of our students are still confronted with much older and less attractive buildings than they are accustomed to in their daily work in industry. Nor does this apply only to the technical or production side but to the social amenities also, and much leeway must be made up if the colleges are to command an equal respect. It would be foolish, not to say impossible for the colleges to attempt to compete with industry in quantity of provision, but they should rather lead than lag behind in the quality of their buildings and general amenities. Unattractive surroundings do not enhance the appeal and reputation of the work done, as Redbrick knows well enough compared with Oxbridge. After the quality of its teachers, there is no single quality more calculated to raise and maintain the reputation of an institution than the grace and adequacy of its buildings and surroundings. Being most evident it is perhaps the most emphatic of all in the short term.

In sum, therefore, it is arguable that many factors have conspired to prevent that proper esteem of technical education which might reasonably be expected in an industrial and commercial nation. In tracing these out, it may be true that we have been indulging in 'the luxury of proving what we already know to be true' or, as is sometimes maliciously suggested of certain psychological investigations, we have been engaging 'in the systematic rediscovery of the obvious'. It is not that its reputation is uniformly low, for on the contrary, some parts of technical education have a very high reputation, but it is rather that it is more unequal and its importance less acknowledged than it should be. The technical colleges responded magnificently to the urgent demands of World War II, and this has been one cause of the renewed interest in technical and technological education since then. After being done for so long, their work began at last to be seen to be done. Now it is mostly a question of encouraging it to be done, a vital question of ends and means with which we shall be closely concerned in this book. While many of our present problems and opportunities also perplexed and haunted our colleagues in pre-war days, it is fair to point out that the scale and pace of developments are now of a quite different order. Table 2 (p. 6) shows that the overall expansion since pre-war days is twofold, but this does not emphasise the changing character of the work, the fundamental change from evening to daytime work, which is clearly seen in the fourfold increase in full-time courses and over sevenfold in part-time day courses; nor does it convey the greatly increased quality of the work.

Important, interesting and instructive though a historical account of technical education would be, our concern here must primarily be to take technical education as it is (as Bernard Shaw remarked to the lady who said she accepted the Life Force—'You'd better'). Our justification is that the post-war change has actually been so great and the potentiality of technical education so enhanced by the Education Act, 1944, that we are in fact living in a quite different era. Not that we can or shall ever be able to escape history when our institutions are its embodiment and moreover when, as Sir Winston Churchill has observed, 'Men make institutions; institutions mould men.' Our task is therefore to give as full an account as possible of the present scope and range of technical education and its institutions, their problems and opportunities and the trends of policy and, more important still, the students, industries and occupations which technical education exists to serve, and the teaching and other staffs who work to that end.

To convey all this, a blend of the general considerations with particular studies has been attempted. Inseparably linked as technical education is with the industrial and commercial world, it cannot remain unaffected by their scientific and technological changes, their economic and social problems. Therefore no static point or period can possibly be found at which to write a wholly valid account of technical education in so rapidly changing a world. All that can be attempted are the firmer outlines of a specification of the first order of accuracy, in the hope that even these will not be blurred too soon by the rapid passage of events. Whatever the difficulties and the consequent shortcomings, one thing is certain; at no period of the history of technical education have the problems been so pressing, the policies so intriguing and the future so encouraging as at the present time.

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CHAPTER II

CHARACTER AND RANGE OF INSTITUTIONS

The art, commercial and technical institutions, the colleges of further education and the national colleges whose work altogether is our main concern have grown up mostly in response to local needs, then increasingly to regional requirements and latterly, since the war, to meet national necessities. Relatively few, hardly one per cent., have been planned *de novo* with no antecedent classes or organised technical school to be transferred to new buildings. One of the best-known examples of this kind in pre-war days was the establishment of the South-East Essex Technical College and School of Art by the Essex County Council in Dagenham. The writer had the fascinating experience of participating in the growth of a college from nothing in September, 1936, to a roll of some 5,000 individual students three years later. It was stimulating to see how the planning for the needs of a large mixed and mainly new industrial urban region did in fact work out, and later to make comparisons with the sister institution, the South-West Essex Technical College and School of Art at Walthamstow, opened in 1938. This was another of four major colleges planned by Mr. (now Sir) John Sargent, and to it was transferred and combined the long-established Walthamstow Technical College and the Leyton Technical Institute, the Leyton School of Art and the Walthamstow Commercial School for Girls. Both these new and thoroughly viable colleges not only met the hopes centred upon them but, as has often happened in a way to confound the planners, their very existence in excellent buildings on fine sites stimulated a further demand beyond all expectation. A post-war example of a completely planned new college (as distinct from simply new buildings) is Hatfield Technical College, and its development will be followed with special interest—if only because everyone likes to keep an eye on the planner.

Most institutions, however, have grown over the years in response to the expressed and anticipated needs of the local industries and community generally. At a varying rate, the result of many factors, the institution has grown until, imperceptibly perhaps or with dramatic suddenness, it has found itself overcrowded. Then has come the struggle, sometimes bitter and almost always unduly prolonged, towards new premises. Seldom indeed have the new buildings proved adequate in size or scope of provision, and as with the Essex colleges there has been the added stimulation of improved conditions. Very soon—all too soon judged by the ratepayers' lament—a new addition or extension is needed and planned and finally built, often with inherent disadvantages which need not have been had the original vision been ample enough and courageously supported. The growth in size and prestige of the institutions was accompanied by the increasing radius of their catchment area, overleaping municipal and county boundaries with all sorts of administrative problems in train, including that of providing further extensions adequate in all senses for advanced work. But the increasing catchment area also made possible courses for which there was insufficient demand locally and this too affected the character and buildings of the major institutions.

As with all living social organisms there is continual interaction between the institutions and their environment. For this reason it may be argued that growth by stages is normal, that future interactions can hardly be foreseen or not at all, and that only when there has been a great neglect in provision, or there is an entirely novel situation (as in a newly created modern town) can a college be planned completely. Nevertheless, there are factors of general application and significance which have operated and continue to influence the work and growth of technical institutions. Indeed these ought to be clearly apprehended in the planning and creation of a new college (p. 554).

At the risk of a misleading oversimplification we may classify these factors as follows—i. the geological and geographical; ii. the population; and iii. the social factors. The briefest examination shows the far reaching effect of i. upon ii. and even upon iii., the effect also of ii. upon iii. and each, individually and collectively, upon the growth and character of institutions.

First and foremost are the geological and geographical factors, because they largely determine the siting of institutions through the industries, commerce and occupations upon which their educational work so largely depends. The interplay of such factors is always complex though one factor may dominate in giving the institution the initial impetus to make a start; to establish its most important department, or, yet again, to determine the general character of the institution as a heavily technological one. On the other hand, a college of further education may more readily appear in the absence of any dominant industry.

In coastal areas there are two main types—institutions in ports and seaside resorts. Most characteristic are the departments and courses to deal with seagoing traffic (p. 412), as in the Department of Navigation at the Cardiff College of Technology, of Marine Engineering at Liverpool College of Technology, and of Naval Architecture at Sunderland Technical College (p. 59). The South Shields Marine and Technical College, with its main departments of Navigation and Marine Engineering and an ancillary Department of Electrical Engineering and another one of Mathematics and Physics, is a clear example of a single dominant factor. The King Edward VII Nautical School, London, may also be cited. In the ports are also to be found wide-ranging courses in business, commerce, economics, banking and languages, and such specialist subjects as port organisation and finance, shipping, shipbuilding and exporting and forwarding. Despite their geographical separation there is close similarity between the courses, for example, at the Liverpool College of Commerce, the Scottish College of Commerce and the City of London College. These differ somewhat though not fundamentally so from the work of a college situated inland at the centre of a vast industrial conurbation which trades with the far corners of the earth. Leeds College of Commerce is an example, and Manchester College of Commerce serves such a region focussed on an inland port.

Courses in hotel-keeping and catering must surely be indispensable to seaside resorts but it is only since the war that these have been generally accepted as a practical necessity and especially because of the work of the Hotel and Catering Institute. The pioneer Hotel School of the Westminster Technical Institute was established as long ago as 1910 to meet the needs of the hotel and restaurant industry of the metropolis, which is at once a port, a great centre of trade and commerce and a unique holiday centre. The departments of Food Technology and of Hotel and Catering at Blackpool Technical College and the Department of Catering at Brighton Technical College are two well-known post-war developments. Such departments are no less important in the large ports and centres of industry and commerce, which require both hotel accommodation and large industrial and office canteens. Examples are the developments at the Leeds College of Technology, the Scottish College of Commerce, the Manchester Domestic and Trades

College and Cardiff College of Technology and Commerce.

Of all natural resources in this country, coal has been of outstanding importance since the beginning of the industrial revolution; in fact, its utilisation was one of the mainsprings of that profound change in Britain's economy and social structure. It is not surprising therefore to find 'Mining' incorporated in the names of technical institutions in the coalfields, as at Wigan, Cannock Chase, Coalville, Barnsley, Dinnington, Castleford, Hemsworth, Ashington, Abersychan. Nuneaton is a recent example of a changing name with widening function, from the 'County Mining and Technical School' to the 'Technical College and School of Art'. The dominant mining interest has become an integral department of the college and there are such mining departments (of varying size and importance in relation to local needs) at Burnley, Canterbury, Chesterfield, Crumlin, Doncaster, Edinburgh (Heriot-Watt), Mansfield, Mexborough, Stoke (N. Staffs College), Nottingham, Oakengates, St. Helens, Rotherham, Sunderland, Swansea, Treforest, Wakefield and Wrexham. Many colleges received grants from the Miners' Welfare Fund, which was produced by a levy of a penny per ton on the output of every coal mine as laid down in Section 20 of the Mining Industry Act of 1920. This fund was devoted to the social welfare and education of the mining community, and it gave a strong stimulus to advanced mining courses.

Another closely related development due to natural resources is the iron and steel industry, with consequent courses in iron and steel manufacture with associated courses and departments in metallurgy and engineering, as at Rotherham Technical College, Sheffield College of Technology and the Constantine Technical College, Middlesbrough. The ceramics department in the North Staffordshire Technical College at Stoke similarly serves the regional needs of the potteries. Yet another specific example was the development between the wars by Imperial Chemical Industries of large works at Billingham-on-Tees, with the anhydrite deposits and the availability of brine. This development stimulated the establishment of the Constantine Technical College, Middlesbrough, and the subsequent expansion of its science courses. It will be interesting to see what further effects will follow from the present I.C.I. development along the Tees at Wilton, and the possible future exploitation of the very large potassium salt deposits near Whitby.

Groups of factors have led to the creation and firm establishment of industries in definite localities, as has been noted in the case of the iron and steel industry. Similarly the conjunction of ample motive power with a humid atmosphere led to the rapid development of the cotton industry and then to textile departments and courses in many Lancashire colleges, as at Bolton, Burnley, Blackburn, Manchester, Nelson, Preston, Rochdale and Salford. Over the Pennines the local raw material had long ago been the basis of the wool textile industry which, with the coming of the industrial revolution and mass production led to departments and courses of wool technology, for example at Bradford, Dewsbury, Halifax, Huddersfield and Keighley. The clothing trade of Leeds and district and the related Department of Clothing Technology at the Leeds College of Technology are clearly derivative from the basic woollen industries. The textiles department of the Dundee Technical College is another example of a particular specialisation within a whole technology, inasmuch as it is concerned with the spinning, weaving and subsequent processing of jute and flax. The growing impact of modern science since World War I is shown not only in the changing character of the foregoing textile courses, but even more in the increasing instruction about such man-made fibres as rayon, nylon, terylene and so on. High specialisation on the new fibres required for the hosiery trade is found in the textile departments at the Leicester College of Technology and the Nottingham and District Technical College and, for rayon particularly at Derby Technical College.

Boot and shoe manufacture derived initially from the products of the shires and livestock farming, and there are such departments at Leicester, Northampton and Norwich. The industry has two main aspects, namely the preparation and processing of leather and its manufacture into leather goods, including boots and shoes. The National Leathersellers' College is concerned with the science and technology of produced finished leather from raw hides and skins which in the United Kingdom alone approaches £100 million per annum in value. The College is situated in London, S.E.1, and thus centrally in relation to markets, commerce and transport. The Cordwainers Technical College, London, E.8, is wholly concerned with the use of leather in the boot and shoe, leather goods and cognate trades, and is an example of a monotechnic.

Two points should not be lost sight of in relation to the technologies dealt with in the foregoing paragraphs. The first is that the advantage of an early start, especially when coupled with the introduction of machines and mass production, led to world trade far transcending the local supply of raw materials and needs upon which the industry was founded. This has had its repercussions in increasing the size and importance of the departments concerned and also to a growing recruitment of overseas students. The boot and shoe manufacturing industry and the iron and steel industry are good examples, but in the main recruitment to the textile departments associated with the cotton industry is deplorably unbalanced. We need not be accused of xenophobia and an irrational desire for economic autarchy when one points out the lamentable lack of trained people in the textile industry as against the need [1], compared with the fact that, for example in Lancashire, some two-thirds of the students in fulltime diploma courses come from abroad. The second point to note is that the development of such specialised departments has in all cases required ancillary courses and has led to the formation of separate departments; thus mining has required engineering, engineering has required mathematics and science, and the last may subsequently result in separate departments of chemistry and physics. On the arts side design has been greatly stimulated by the needs, for example, of the textile and printing industries as at Leicester Regional College of Art.

Mention has been made of the impact of modern science on the textile industries, but the effects have been much wider than that. Indeed, both the character and distribution of industry have greatly changed in consequence. The first consequence has been to free industry from a particular location, determined by one particular factor or natural resources such as water and coal, which the distribution of electric power has recently made possible in the siting of light industries. Factories could thus be nearer to ports and markets rather than to sources of supply and power and this was a major factor in the drift of industry from the north and especially into the industrial belt around London. The same considerations have made both possible and desirable the creation of large manufacturing and trading estates such as Trafford Park, Manchester, and the Slough Industries and Trading Estate.

The same increased flexibility has made it possible to re-invigorate 'depressed areas' afflicted with the problems of declining industries. For example we may note the Welsh Trading Estates which began in 1936 as a result of the Special Areas (Development and Improvement) Act of 1934. These have had repercussions on the work of technical colleges in intricate and far-reaching ways indicative of the complex relationships of work, college, home and travelling in which they normally function. The first estate at Treforest is near to the Glamorgan Technical College and close links have been made between the firms on the estate and the college. But owing to the distances which employees have to travel in this area, other colleges also provide training for students working on the estate; for example, the Rhondda Technical Institute has a substantial number of Trading Estate apprentices in attendance. Regionally the Cardiff College of Technology and Commerce is also affected and, for example, discussions are in progress about providing facilities regionally for plastics firms. The Bridgend and Wrexham Trading Estates are served by the colleges in those towns, but the Hirwaun Estate is an isolated one with the result that apprentices are trained in colleges near their homes, as at Merthyr, Neath and Rhondda.

That these repercussions are inseparable from the essentially modern scientific industries which have contributed most to these estates will be seen from a brief list of their products: 'medicinal products, glassware, optical equipment, radio and television sets, electric light bulbs and fluorescent fittings, precision tools and fire extinguishers, dental and surgical instruments, clothing, furniture, typewriter ribbons and carbon paper, chemicals, musical instruments, aircraft controls and components, paint and varnish, electrical switchgear and vacuum flasks, rubber products, clocks and watches, plastics, celanese, nylon, washing machines, air and sea rescue apparatus, steel fabrication and light engineering industries of many kinds' [2]. Very comparable lists could be given for other such estates elsewhere in Great Britain, and the high degree of similarity is made possible only by the application of modern science and technology.

The consequences on the work of technical institutions of these far-reaching changes have been profound. Most notable of all has been the increase in the number and range of scientific subjects taught in them. This is because chemistry, physics and mathematics are fundamental to any real understanding of technological processes and developments. No major college can hope to have successful technological departments, such as engineering, without equally important scientific departments (whether they are acknowledged to be so or not). But this alignment of technology and science is important at all levels which explains the very wide provision of science in technical institutions.

In *Technics and Civilisation,* Lewis Mumford follows Professor Patrick Geddes in defining overlapping and inter-penetrating but nevertheless quite distinct phases of development of the machine civilisation [3]. He distinguishes three such phases:

the *eotechnic* as the dawn of modern technics, the wind-wood-and-water phase
the *paleotechnic* phase which is a coal-iron complex, and
the *neotechnic* phase which is an electricity-and-alloy complex.

Lewis Mumford fixes the eotechnic phase broadly as from the year 1000 to about 1750, the paleotechnic phase succeeding it and lasting until about 1900, when the neotechnic is clearly discernible. Every student of technical education is recommended to see how Lewis Mumford develops his fascinating thesis; here we can only accept it and to it add one further phase, which was emphasised by Charles S. Munson on the occasion of his being presented with the Society of Chemical Industry's Medal for 1953 [4]. This is the Chemical Age, or the Physico-chemitechnic phase. Each phase has been shorter than its predecessor with an increasingly rapid succession; this last began about 1939 and even now is ushering in the Atomic Age which may prove to occupy but microseconds of man's history in bringing about his destruction, or compel him to be human and refound his whole civilisation on an amplitude of energy. We may then exemplify the successive phases briefly in tabular form:

TABLE 6

PHASES OF TECHNOLOGICAL DEVELOPMENT

Eotechnic	*Paleotechnic*	*Neotechnic*	*Physico-chemitechnic*
Waterpower	Steam/coal power	Electric power	Atomic energy Electronics
Wood fire	Coal and gas fires	Electric fire	Atomic energy?
Wood	Iron and steel	Aluminium and light alloys	High temperature—stress alloys
Cart	Railway (steam)	Motor car and aeroplane	Jet plane
Quill pen	Steel pen	Fountain pen (plastic)	Dictating machine (electromagnetic)
Speaking tube	Telephone and morse	Radio	Televisophone?
Portrait	Photograph	Cinema	Television, telechrome
Woven wool	Spun cotton	Rayon	Nylon, terylene, orlon, etc.

We may therefore expect the work of technical institutions to follow the general line of development pictured here and the scientific content to increase accordingly. The science courses have become as essential to craft education as to the technological because of the nature of the new materials and processes characteristic of this physico-chemitechnic phase (Chapter XIV).

Initial geographic advantages at a focal point of communication through valley and hill passes can become the basis of very large developments especially with later discoveries of natural resources. These in turn lead to an emphasis on transport, which makes new developments possible. Not the least important cumulative effect is the gathering together of a lively forward-looking community which seeks further developments still. Many examples could be given of this cumulative historical interaction based on intergeographical advantages, but Derby is a case in point. For these reasons Derby became a market town in the Middle Ages, with an increasing emphasis on trade (e.g. in pottery and silk) and transport, especially with the development of natural resources in the Derbyshire/Nottinghamshire coalfields. This led to Derby becoming a railway town and to the establishment of associated engineering workshops. This in turn attracted other engineering industries requiring diverse raw materials from many places and wide dispersal of their products. The most notable development was the establishment there of the famous firm of Rolls Royce Ltd., about 1905, because land was cheap, transport good and there was a supply of trained engineers. Engineering is thus a major department of the Derby Technical College as a direct consequence of all these cumulative developments in the city and region.

The cumulative effect is shown also in the establishment of special markets and, with them, of special trades and the necessity to provide for them. Thus Barrett Street Technical College, Oxford Street, London W.1., which is the central college in London for training for the dress industry, with courses also in tailoring, furriery and hairdressing, and the Shoreditch College for the Garment Trades, are appropriate examples.

Another aspect of this cumulative effect of many factors is the population and industrial catchment area, which sets a limit to the potential size of an institution and the diversity and level of its work. This may be seen from a perusal of the details of the institutions given later in this chapter which is one of the reasons for choosing them. Thus the Salisbury and South Wiltshire College of Further Education illustrates an institution in a county town at the centre of an extensive but thinly populated area and necessarily working through several dispersed branches. The Workington College of Further Education is also in an isolated area but is responding to the invigorating challenge of a transformed 'distressed area'. It also illustrates a present trend in a change of title, in July, 1954, from that of Cumberland Technical College. Lancaster and Morecambe College of Further Education has arisen from the fusion of the Storey Institute, Lancaster, with origins going back to a Mechanics Library of 1824 and Institute of 1841, with another institute in Morecambe. It thus attempts to meet the growing needs of two quite different communities, and will do so increasingly in new buildings on a fine open site between the two centres. Two other colleges meeting the challenge of the modern world in cities of ancient origin are those of Gloucester and Norwich and their influence extends well beyond the city walls, as shown in Diagram 3.

Different again is the Brighton Technical College which is particularly interesting in that, for a college in a seaside resort, its work is surprisingly high in standard and academic in character. This can be largely explained by Brighton's special character as a residential town in relation to London, and the extent and resources of the large hinterland served by the College. At the same time, in the absence of heavy or extensive industry it has comparatively few day-release students. The Dudley and Staffordshire Technical College is an example of a college whose work in a heavy industrial area cuts across borough and county boundaries. This led to the establishment of a Joint Education Committee to act as a Governing Body in 1935, and its work has prospered greatly since then. Rugby College of Technology and Arts is included partly because in its Electrical Engineering Department it exemplifies excellent support from industry, and partly because of its unique history in part-time day education for young workers in industry since the Act in 1918.

In the largest centres of industry and population the pressure of work and problems of organisation and diversity of origin are apt to produce and maintain separate colleges of various kinds each able to maintain work at a high level. Thus in Liverpool there are separate Colleges of Technology, Building, Art and Commerce respectively. The last named has been chosen to exemplify one aspect of this separation, which appears again, for example, in Leeds, and in this case the details of the College of Technology are given below. At Leicester there are the College of Technology and Commerce and the College of Art, and the latter is chosen to exemplify a Regional College of Art. In Cardiff there is a similar differentiation and in this case the College of Technology and Commerce is the institution selected to exemplify certain general

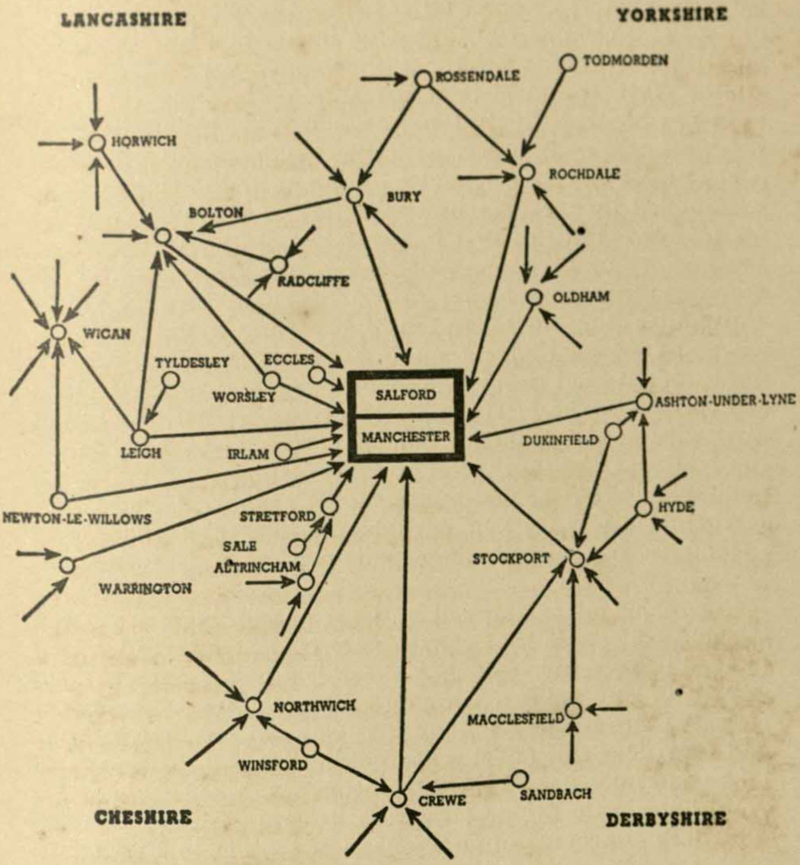

DIAGRAM 2. REGIONAL ARRANGEMENTS OF COURSES

MANCHESTER AND DISTRICT ADVISORY COUNCIL
FOR FURTHER EDUCATION

Diagrammatic map, reproduced from the Council's publication *A Student's Guide to Engineering Education in the District in and around Manchester, 1953–1954.*

The map gives an indication of the area in which the Council is interested, and gives some idea of the directions of flow for the various grades of work as a student progresses towards the most advanced forms of Engineering Education.

features of the work of large technical colleges and also to bear in mind the particular commercial importance of Cardiff in the Principality. For a similar reason the Glasgow and West of Scotland Commercial College is included, while the other Scottish example is on the technological side, namely the Heriot-Watt Technical College, Edinburgh. Both these colleges are Scottish Central Institutions and the Heriot-Watt College has an affiliation with the neighbouring university (Chapter XVI). In England recognition by the University is exemplified by the Manchester College of Technology which for many years has acted in respect of its major courses as the Faculty of Technology of Manchester University, but is now in process of becoming a constituent institution of the University; the Northampton Polytechnic, London, E.C.1, serves as an example of an institution recognised for the award of internal degrees in engineering of London University (p. 162). The Northampton Polytechnic has also associated with it the National College of Horology, the first of the National Colleges. Yet another example of university affiliation is that of the Sunderland Technical College with Durham University, and Cardiff College of Technology and Commerce has also arrangements with the University of Wales.

One major factor, implicit in the growth of large communities and colleges is that of adequate transport facilities. To be readily accessible by bus and rail is a potent factor in the growth of any college, a factor of great importance in the choice of site for new buildings or any entirely new college. Not only does this affect a college directly but it has a most important influence on the integration of any regional scheme of technical education. Diagram 2 shows such a regional contributory scheme of engineering education in the North-west, and the general problem of flow coincides very closely with radiating and interconnecting transport arrangements. It is because they have a significant part in this scheme, which influences the character of each, that details have been included below of the Stretford Technical College as a contributory technical college. Stretford has a large volume of work up to Ordinary National Certificate and equivalent standard, and its students proceed thereafter to Manchester College of Technology and to the Royal Technical College, Salford. This Diagram 2 has other implications which will be considered under Higher Technology in Chapter XV, but the number and diversity of colleges is a characteristic feature of such a heavy industrialised region, and is found also in Birmingham and district. There the Birmingham College of Technology is the regional institution, exemplifying a high concentration of advanced work in many technologies, with progressive shedding of courses of Ordinary National Certificate standard and below to contributory colleges.

One effect of travelling facilities and the pressure of population is the separation of home and work already mentioned in connection with the Welsh Trading Estates. This also results in the immense burden of daily travel in and out of London. The would-be student has the choice of studying near his work or home, but generally prefers the former. He takes advantage of better facilities centrally and avoids the hazards of travel beforehand, which may make him late for his class or prevent his arrival in time to make it worthwhile attending at all. Thus we have the growth of such institutions as the City of London College (now in its 108th Session) and the Kennington College of Commerce and Law; their work is largely conducted through evening classes and is a constant refutation of the idea, as there is in other colleges, that a high standard of advanced and specialised work cannot be conducted in evening classes. Where part-time day arrangements obtain, the student's choice is likely to favour classes near home in order to save onerous travelling time.

In sharp contrast to the many colleges 'cheek-by-jowl' in the North-west, we have those colleges which are relatively isolated and must serve their area or region in a fuller and less differentiated way. Mention has been made of the colleges at Salisbury and Lancaster, but Diagram 3A is the analogous diagram for the almost completely isolated Norwich City College and School of Art. The nearest technical college to Norwich is about thirty miles from the outer limit of its 80% catchment area. As an intermediate case Diagram 3B shows the work and overlap of catchment areas of a small group of colleges at Gloucester, Stroud and Cheltenham. For this group of three colleges the concentric rings show an interrelatedness which is completely absent for Norwich. The intersections of these circles pin-point the problems and issues of regional catchment and organisation, the solution of which are completely determined by natural resources, communications (bus routes and railways), local initiative in supplying special courses, the need to conserve teaching power and special equipment. The 80% catchment area for Gloucester Technical College is the shaded area, that for Stroud and District Technical College is the circle of 5 miles radius (that for Cheltenham was not available).

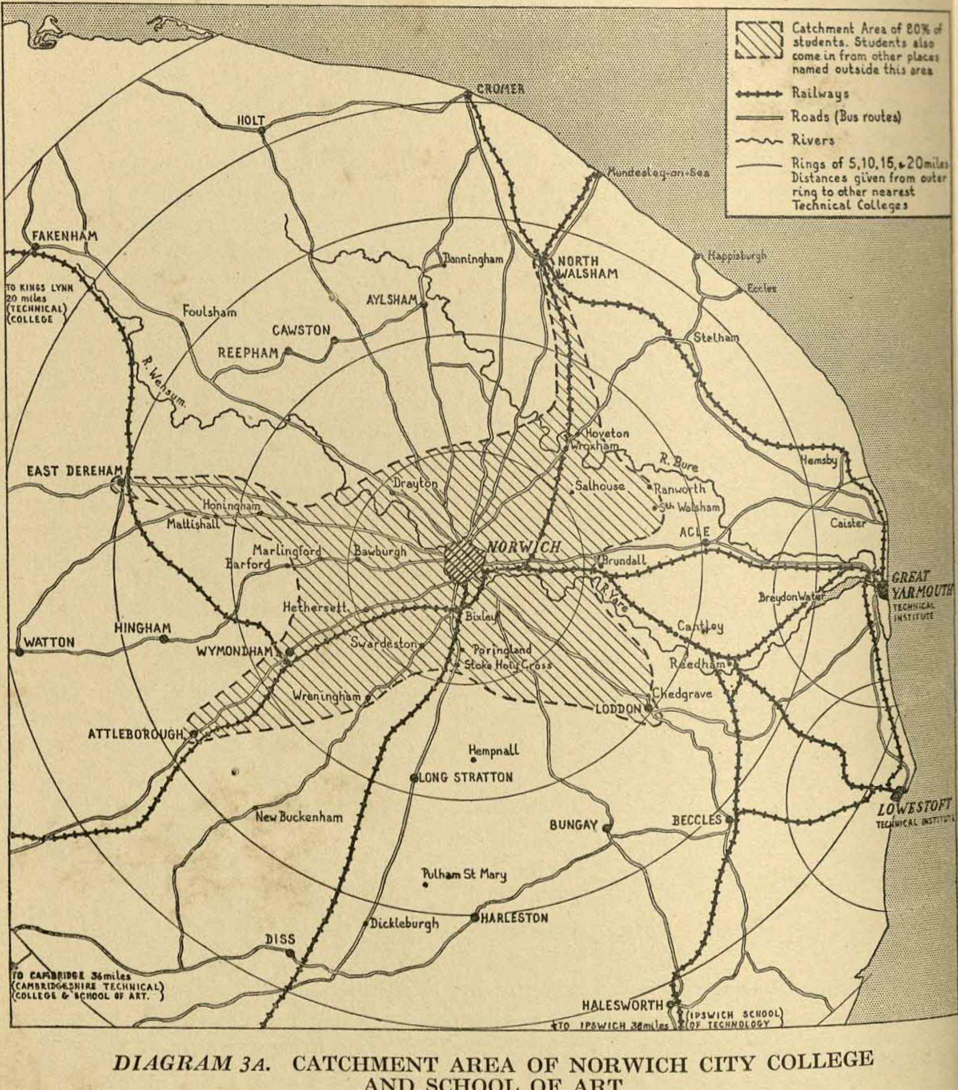

DIAGRAM 3A. CATCHMENT AREA OF NORWICH CITY COLLEGE AND SCHOOL OF ART

The greatest pressure of population and diversity of needs is shown best in the technical institutions in and around London, which of itself makes any selection scarcely more than arbitrary. However, the Polytechnics are represented by two already referred to, namely, The Polytechnic, Regent Street, London, W.1, and The Northampton Polytechnic, Clerkenwell,

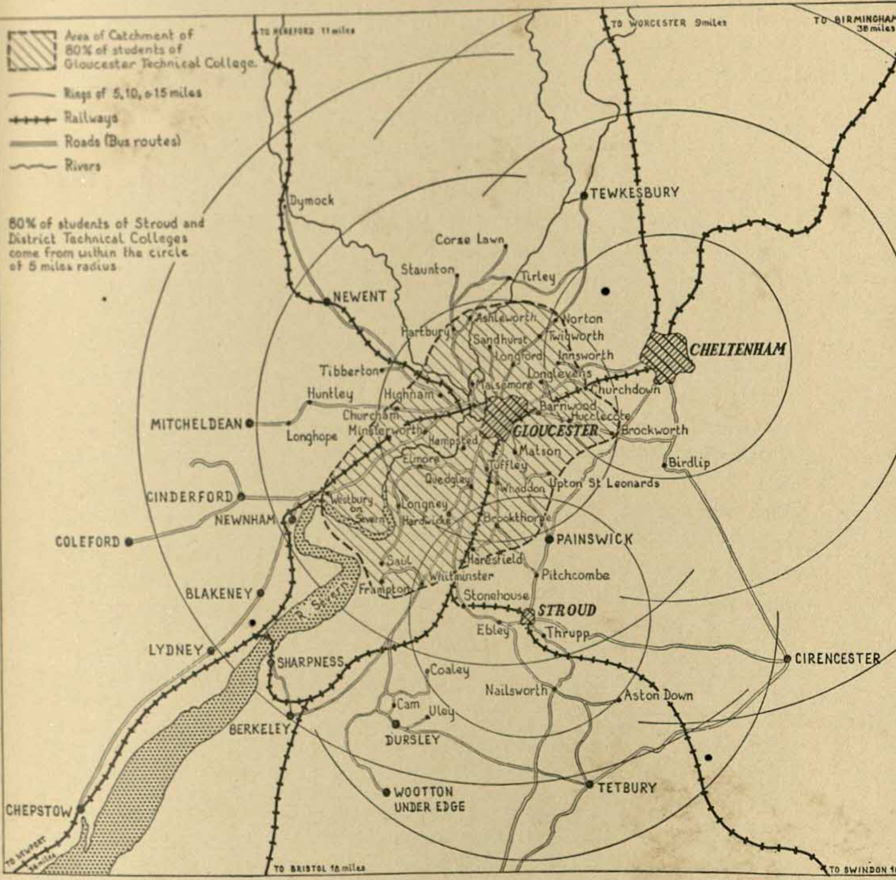

DIAGRAM 3B. CATCHMENT AREA OF COLLEGES

London, E.C.1. Both are administered on behalf of the Charity Commissioners in accordance with City of London Parochial Charities Act of 1883. Their main source of finance is from the London County Council and they are known as 'aided' institutions. The diversity is represented severally by the Barrett Street Technical College, the London School of Printing and Graphic Arts, and by the Brixton School of Building.

Material, geological, geographical and economic factors have exercised powerful influences over the development of technical institutions, but it would be misleading to give them pride of place. They have broadly determined the general make-up of the colleges, but not their quality. This has been and remains due, as with all human institutions, to the inspiration of their founders and the quality, perseverance and zeal of those who through the years have striven to make them at least equal to the challenge of the times. There are honoured names in the history of every institution but it would not be invidious to mention the devoted labours of Quintin Hogg as the founder of the Regent Street Polytechnic and, more recently, the determined creativeness of Dr. Herbert Schofield, C.B.E., in the development of Loughborough College [5], now sundered into several institutions of which the College of Technology is included here.

The foregoing are some of the reasons for the selection of 25 institutions to represent the great range and diversity of art, commercial and technical education, which is carried out in about 590 institutions altogether. This selection, from the lists in Appendix, p. 587, may well raise more problems than it solves, but clearly some institutions would select themselves whoever compiled the list, though many alternatives present themselves when we are considering medium-sized and smaller institutions. However, it is hoped that the selection made may justify itself as exemplifying the varied history and work of technical institutions, and the interplay of the many factors enumerated above which have influenced their development.

The following points should be borne in mind concerning the details given of the selected colleges; the number of evening students do not include part-time day students who also attend in the evening; research students are those actively engaged on research, e.g. for higher degrees, on D.S.I.R. grants, for industrial firms, research associations, etc.; the post-advanced graduate courses do not include those for completion of professional qualifications, e.g. from Higher National Certificate to A.R.I.C.; teaching staff, full-time, includes the Principal and Heads of Department; evening teaching staff do not include full-time staff undertaking extra duties; departments are those recognised as such under the Burnham Technical Report, while other sections of work have not that status; only the more important high level courses are given under Standard and Range of Courses; the general statement (unavoidably all too brief) is based on a synopsis kindly submitted on request by the Principal concerned. The figures given, as those of all the colleges in Appendix, pp. 587–603 are wherever possible, those of the 1952–3 session. Many colleges are still expanding, especially those with new buildings, but figures at a given date afford some basis of comparison.

SALISBURY AND SOUTH WILTSHIRE COLLEGE OF FURTHER EDUCATION

Date Established. Initially 1947. In present form October 1947.

Previous Names of the Institution. Salisbury Evening Institute.
Salisbury Technical College.

Governance. Maintained; Wiltshire Education Committee.

Students. 214 Full-time Senior. nil Junior.
600 Part-time Day Release. nil Other Part-time Day.
1,661 Evening. nil Research. nil Post Advanced/Graduate Courses.
2,141 Total Individual Students.

Teaching Staff. 22 Full-time. nil Part-time Day. 87 Evening.

Sections of Work. Commerce; Domestic Science; Engineering; Building and Science.

Standard and Range of Courses
Intermediate University and Professional. General Education.

General Statement

During its rapid six years' growth of from 300 to more than 2,000 students, the College has been confronted not only with the usual problems, but also with difficulties arising out of a very extensive student catchment area and the provision of facilities for transitory Service personnel.

The scope of the courses available sometimes surprises those who think of Salisbury only as a delightful Cathedral City, and the centre of a predominantly agricultural community for the pattern of such Courses clearly reveals that the community served is as broadly representative as that of any area generally accepted as 'industrial'.

Stress is laid upon the cultivation of character as well as of mind, and of a congenial family atmosphere in the College. Besides the usual means of Student Union activities, contacts with parents and employers, visits are arranged to the Residential College at Urchfont Manor, and a College Service is held each term in Salisbury Cathedral.

WORKINGTON COLLEGE OF FURTHER EDUCATION

Date Established. Initially 1912. In Present form 1945.

Previous Names of the Institution. Workington County Technical and Secondary School. The Cumberland Technical College.

Governance. Maintained; County Council.

Students. 27 Full-time Senior. 260 Junior.
1,127 Part-time Day Release. nil Research.
60 Other Part-time Day. 980 Evening.
nil Post Advance/Graduate Courses.
2,542 Total Individual Students.

Teaching Staff. 90 Full-time. 10 Part-time Day. 82 Evening.

Departments. Engineering; Mining; Secondary Technical.

Other Sections of Work. Building; Commerce; Women's Crafts.

Standard and Range of Courses

Higher National Certificate in Mechanical Engineering, Electrical Engineering and Metallurgy. City and Guilds' Final level in Building and Engineering subjects. Mining Courses to Undermanagers' standard. Surveyors' Courses to Chartered Surveyors' standard.

General Statement

The College serves West Cumberland, one of four areas scheduled as 'Special Areas'.

In 1912, technical education was organised through the County Technical and Secondary School, under a Secondary School Headmaster, and in 1945 the two Institutions were separated. During 1945, the Cumberland Technical College (now known by above title), came into existence, under its own Principal. At that time, some 1,490 students attended mainly evening classes. Advanced work was extremely limited.

Substantial additions have since been made to laboratories, workshops and other specialised teaching space, and in 1952 part-time day classes accounted for more than half the total enrolment, with a much greater volume of advanced work. To-day, the picture is of a distressed area transformed, with expansion in all directions and a feeling of achievement and promise, in which the College with its further education facilities is playing its part.

HATFIELD TECHNICAL COLLEGE

Date Established. 1952.

Governance. Maintained; Hertfordshire County Council.

Students. 112 Full-time Senior. nil Junior.
1,045 Part-time Day Release. nil Research.
17 Other Part-time Day. 864 Evening.
18 Post Advance/Graduate Courses.
2,056 Total Individual Students.

Teaching Staff. 54 Full-time. 5 Part-time Day. 111 Evening.

Departments. Technical and Design Engineering; Works and Production Engineering; Building; Commerce; Social and Professional Studies; Science.

Standard and Range of Courses

Higher National Diploma in Engineering. Higher National Certificates in Aeronautical, Mechanical, Electrical and Production Engineering. Associate Fellowship Royal Aeronautical Society. Post Graduate Training in Aeronautical Engineering: London University B.Sc. (Gen.). Social Studies Diploma. Institute of Bankers, Banking Diploma.

General Statement

The College is a new institution serving a catchment area of approximately ten miles radius in Mid Herts, including St. Albans, Welwyn Garden City, Hertford and Barnet, etc. It is housed in a new building, notable for its distinctive contemporary architecture, on a site of 90 acres which includes ample facilities for sport and athletics. There is an exceptionally well equipped stage and hall, staff and student common and working rooms and specialised aeronautics laboratories. There has been rapid growth since September, 1952, and over 180 employers send students.

Regional status in Aeronautical Engineering has already been granted by the London and Home Counties and East Anglian Advisory Councils.

A unique feature is the four-term year in which each term is eleven weeks with a week's interval and holidays, except for August, corresponding to industrial holidays. Each teacher is off duty for one term in four, part of which he devotes to an approved activity—industrial experience, research, etc. A serious attempt to integrate the humanities with technology is being made and all students spend some time in the Social Studies Department. There are special advanced short courses in aeronautics and management.

LANCASTER AND MORECAMBE COLLEGE OF FURTHER EDUCATION

Date Established. Initially 1824. In present form 1950.

Previous Names of the Institution.

1824. Mechanics and Apprentices Library.
1841. Mechanics Institute.
1860. C. of E. Instruction Society.
1886. Storey Institute.

Governance. Maintained; Lancashire County Education Committee.

Students. 60 Full-time Senior. 160 Junior.
668 Part-time Day Release. nil Research.
145 Other Part-time Day. 1,762 Evening.
nil Post Advanced/Graduate Courses.
2,810 Total Individual Students.

Teaching Staff. 24 Full-time. 14 Part-time Day. 104 Evening.

Departments. Chemistry; Engineering.

Other Sections of Work. Building; Commerce; General Education; Domestic and Catering.

Standard and Range of Courses

A.R.I.C. (part-time). Higher National Certificate in Chemistry and in Electrical Engineering. Ordinary National Certificate in Mechanical Engineering and in Building Courses for City and Guilds Examinations. Full-time Secretarial Course.

General Statement

The College has developed from one of the earliest Mechanics' Institutes into a widely-based College of Further Education, which is the natural focus for all further education work in its area. It serves a population of about 120,000 in a catchment area of some 30 miles by 20 miles. Acts as a centre for societies and lectures, e.g. The Frankland Chemical Society (President: Sir Robert Robinson, O.M., F.R.S.) which attracts lecturers of international repute. First phase of new buildings brought into use in September, 1953, and the whole project, on an open site of 25 acres, will cost between £600,000—£700,000.

RUGBY COLLEGE OF TECHNOLOGY AND ARTS

Date Established. Initially 1920. In present form 1937.

Previous Names of the Institution. Mechanics Institute (before 1900).
Technical and Art School (*c.* 1920).

Governance. Maintained; Warwickshire Education Committee.

Students. 13 Full-time Senior. 50 Boys and 50 Girls, Junior.
1,644 Part-time Day Release. 157 Other Part-time Day.
1,800 Evening. 3 Research for M.Sc., etc.
115 Post Advanced/Post Graduate Courses.

3,444 Total Individual Students.

Teaching Staff. 51 Full-time. 12 Part-time Day. 120 Evening.

Departments. Electrical Engineering; Mechanical Engineering; Pure Science and Metallurgy; Commerce and General Education; Building; Art; Housecraft.

Other Sections of Work. Day Continuation School (Boys and Girls). Youth Employment Service for the Rugby Area is operated from the College; the Principal acts as Youth Employment Officer.

Standard and Range of Courses

B.Sc. (Eng.), H.N.C. Electrical and Mechanical and Production. B.Sc. (Gen.). B.S. (Special) Physics, Chemistry. Associate Royal Institute of Chemistry. H.N.C. Chemistry. Above approved for higher technology grant under Circular 255 (pp. 471, 607).

General Statement

The College has developed from 'Mechanics Institute' classes in the nineteenth century—through a period of progressive expansion since the beginning of the present century. Up to 1929 borrowed premises were still in use, but the increasing demand for technical education by the rapidly expanding local industries compelled the expansion of further education in the town, so that the Local Authority prepared a building scheme which, by the completions of instalments in 1937, 1941 and 1952 has resulted in the present dignified modern building standing in six acres of playing fields and containing well-equipped classrooms, laboratories, workshops and lecture rooms.

The development of the College has been achieved with the closest co-operation with industry, which is made evident in the provision for the daytime release of apprentices for college attendances, in the generous gifts of equipment throughout the whole period of collaboration, as well as in the close and friendly day to day contact of educational and industrial experts.

The College has maintained since 1920 the only compulsory Day Continuation School in the United Kingdom. The attendance at College of all young persons between fifteen and sixteen years of age for one working day each week is a statutory provision which is peculiar to Rugby. The facilities for general education provided in the Day Continuation School, together with the almost universal release of apprentices in building and engineering, provide opportunities for liberal, art and technological education which are unique.

CITY OF GLOUCESTER TECHNICAL COLLEGE

Date Established. Initially 1873. In present form 1947.

Previous Names of the Institution. The Science School.
The Technical School.

Governance. Maintained; City of Gloucester Education Committee.

Students. 71 Full-time Senior. nil Junior.
1,191 Part-time Day Release.
118 Other Part-time Day. 1,931 Evening. 1 Research.
137 Post Advanced/Graduate Courses.
2,826 Total Individual Students.

Teaching Staff. 41 Full-time. 12 Part-time Day. 122 Evening.

Departments. Science; Commerce; Mechanical Engineering; Electrical Engineering; Building.

Other Sections of Work. Domestic Science.

Standard and Range of Courses

A.R.I.C. (full-time and part-time). Higher National Certificates in Mechanical Engineering, Electrical Engineering and Chemistry. B.Sc. (Gen.) London University External (part-time). Post Advanced Courses in chemistry, metallurgy, electrical engineering. Courses for City and Guilds Examinations. General education and non-vocational subjects.

General Statement

The Students' Union is very active with usual range of clubs, dramatic performances and fortnightly dances in the College Hall, making a close knit College community with the staff taking an active part in the social life. There is an Annual Cathedral Service and the Senior Canon acts as an honorary lecturer in giving series of lectures to full-time students. Foreign Exchange visits for students are arranged with educational institutions on the Continent. The College Refectory is run as a separate unit under the Principal's control and the profits are devoted to many worthwhile activities, e.g. sending lecturers to visit other colleges and works, entertaining visitors, etc.

THE NORWICH CITY COLLEGE AND ART SCHOOL

Date Established. Initially 1901. In present form 1935.

Previous Names of the Institution. Municipal Technical Institute.
Norwich Technical College.
Technical College and School of Art, Norwich.

Governance. Maintained; Governing Body composed of the 24 members of Norwich Education Committee and 4 representatives of the Norfolk Education Committee.

Students. 367 Full-time Senior. 329 Junior.
2,614 Part-time Day Release.
458 Other Part-time Day. 2,225 Evening. nil Research.
nil Post Advance/Graduate Courses.
5,993 Total Individual Students.

Teaching Staff. 87 Full-time. 29 Part-time Day. 191 Evening.

Departments. Engineering; Science; Commerce and Languages; Building; Art; Catering and Domestic Science; Boot and Shoe.

Other Sections of Work. Printing.

Standard and Range of Courses

B.Sc. (Eng.). B.Sc. A.R.I.C. Higher National Certificate (Mechanical and Electrical Engineering, Building). National Diploma in Design.

General Statement

During the period 1901 to 1935 the College incorporated the Mechanics' Institute, the School of Art, evening classes in science and art, the Norfolk and Norwich School of Cookery, and finally the Literary and Commercial Institute.

Between 1949 and 1953 a new building was erected and in this about three-quarters of the work of the College, which had rapidly expanded since 1944, is conducted, the remainder being in the old establishment.

As a result of its geographical situation the College attracts students from an area within a 25 miles radius of the city, about one-third of them being out-county. The population density in this predominantly agricultural area is quite low and this means that advanced classes have to be conducted with relatively small numbers. The College, in fact, naturally serves as a focal point for more advanced studies over a wide area in East Anglia.

DUDLEY AND STAFFORDSHIRE TECHNICAL COLLEGE

Date Established. Initially 1862. In present form 1935.

Previous Names of the Institution. Dudley Mechanics' Institute.
Dudley Technical College.

Governance. Aided: Joint Education Committee (Dudley and Staffordshire Local Education Authorities).

Students. 51 Full-time Senior. 297 Junior.
1,204 Part-time Day Release. 224 Other Part-time Day.
3,067 Evening. nil Research.
36 Post Advanced/Graduate Courses.
4,879 Total Individual Students.

Teaching Staff. 46 Full-time. 14 Part-time Day. 192 Evening.

Departments. Mechanical Engineering; Electrical Engineering; Civil and Structural Engineering; Production Engineering and Engineering Trades; Commercial and General Education; Women's Department; Art; Building.

Other Sections of Work. Adult Education; Physical Training; Clothing Trades.

Standard and Range of Courses

Higher National Certificate, Civil, Electrical, Mechanical and Production Engineering. National Diploma in Design. Ordinary National Certificate, Building, Commerce, Metallurgy. Professional Examinations (Commercial).

General Statement

The College, as at present constituted, began in a new building, a first instalment of a larger project, in 1935, with 840 students in all. It was recognised that new premises would attract increased numbers of students and it was assumed, too optimistically in the opinion of many, that in these improved conditions numbers would be doubled. In fact, by 1939 the total numbers had reached 2,160 and in 1953 were about 5,000.

Probably the most interesting feature of this College is the way in which local authorities' boundaries may be broken down in technical education. Recognising the need to consider the area as a whole the Authorities mainly concerned—Dudley County Borough and Staffordshire County—set up a Joint Committee, to be responsible for the building and running of a technical college to serve the area. Responsibility for capital costs is shared equally between the sponsoring bodies. So far as running costs are concerned the expenditure remaining after contributions have been received in respect of extra-district students, is shared between the two providing Authorities in proportion to their use of the College. In fact, Dudley, in whose area the College is situated, supplies about 31% of the students (p. 490).

The building itself is very pleasantly situated in sylvan surroundings and yet not more than five minutes' walk from the centre of Dudley. The site is about 5½ acres in extent. In addition to the first and main instalment opened in 1935, three sets of extensions have been added, and provision is made for four additional phases on the present site.

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BRIGHTON TECHNICAL COLLEGE

Date Established. Initially 1897. In present form 1897.

Previous Name of Institution. No change.

Governance. Maintained; Brighton (County Borough) Local Education Authority with block grants from East and West Sussex Local Education Authorities.

Students. 862 Full-time Senior. nil Junior.
514 Part-time Day Release. 222 Other Part-time Day.
2,506 Evening. 3 Research.
68 Post Advanced/Graduate Courses.
4,175 Total Individual Students.

Teaching Staff. 95 Full-time. 34 Part-time Day. 148 Evening.

Departments. Mathematics; Physics; Chemistry; Biology; Pharmacy; Mechanical Engineering; Electrical Engineering; Civil Engineering and Building; Arts and Social Studies; Economics and Commerce; Domestic Studies; Catering.

Other Sections of Work. Bakery.

Standard and Range of Courses

Full-time: B.Sc. Engineering; College Diploma in Civil and Structural Engineering; H.N.D. Mechanical Engineering, Electrical Engineering, Building. B.Sc. General and Special (Physics, Chemistry, Botany, Zoology). Associateship of Royal Institute of Chemistry; B.Pharm. and Ph.C. A.R.I.B.A. (Jointly with Brighton College of Art and

Crafts). B.Sc. Economics; B.A. General and Honours (English, French, History); Librarianship (A.L.A.).

Part-time: H.N.C. Civil Engineering, Mechanical Engineering, Electrical Engineering, Production Engineering, Building. Diploma in Public Administration; Institute of Bankers, etc.

General Statement

Situated at the centre of communications of the geographical county of Sussex, the College serves as a 'Regional College of Further Education' for this area. A system of contributory colleges exists and is in process of further development.

The absence of any University College in this part of the country had undoubtedly conduced to the remarkable development of full-time courses which constitute the most prominent feature of the work of the College. Since the establishment, thirty years ago, of courses leading to External Degrees of the University of London 797 such degrees have been gained, while a very large number of other students have attained the professional and technological qualifications to which reference has been made above.

For certain full-time courses, notably in Civil, Structural and Electrical Engineering (in which the College Diplomas are recognised for exemption purposes by the I.C.E. and I.Struct.E. and I.E.E.), in Mechanical and Electrical Engineering, in Pharmacy (for the statutory qualifications in which the College is one of the approved institutions), in Librarianship and in Catering, students are drawn from all parts of the country and from overseas. Certain advanced courses are recognised for increased grant under Circular 255 (pp. 471, 607).

LEICESTER COLLEGE OF ART

Date Established. 1896.

Previous Names of the Institution. School of Arts and Crafts. College of Arts and Crafts.

Governance. Sub-Committee of the Leicester Education Committee.

Students. 290 Full-time Senior. nil Junior.
714 Part-time Day Release. 26 Other Part-time Day.
1,889 Evening. nil Research.
nil Post Advanced/Graduate Courses.
2,035 Total Individual Students.

Teaching Staff. 49 Full-time. 24 Part-time Day. 85 Evening.

Departments. Architecture; Building; Industrial Design; Printing; Dress Design; Drawing and Painting; Teacher Training.

Other Sections of Work. Furniture; Metalwork and Silversmithing; Sculpture and Pottery; Painting and Decorating; Corsetry.

Standard and Range of Courses

Art Teacher's Diploma. Final Associateship of the Royal Institute of British Architects. Ordinary National Certificate and Higher National Certificate in Building. Intermediate Royal Institute of Chartered Surveyors in Quantities and Building. Intermediate Auctioneers and Surveyors. General Building Course for L.I.O.B. Building Foremanship Course. National Diploma in Design three-year

Special Courses, two-year Special, and Main and Additional. City and Guilds of London Institute Examinations in many subjects.

General Statement

It will be noted that the College has possibly one of the widest ranges of courses in the country, in textiles and shoe design in co-operation with the College of Technology.

The College of Art has given a lead in design, educationally, civically and industrially, and was largely responsible for the high standard of lettering on the façades in the city. The College has been responsible for the design of much of the publicity for the city, and for the many departments of the Corporation, e.g., Electricity, Transport and Police.

From industry, enquiries are made almost every day with reference to some aspect of design and students who have left the various departments of the College find posts not only in the city, but are sought nationally, particularly in printing, typography design, commercial art, dress design, corsetry design, shoe design, as well as furniture, and interior decoration.

The College of Art, with its staff, was associated with the design of many of the passenger amenities for British Overseas Airways Corporation, and its insignia, and for advising many of the larger industries, e.g. for mural decorations for works canteens. Architects have asked for co-operation in sculpture and decoration for schools.

There are hostel facilities, refectories, playing fields, gymnasia and students are admitted from all parts of England and from abroad.

LIVERPOOL COLLEGE OF COMMERCE

Date Established. Initially 1924. In present form 1931.

Previous Names of the Institution. Liverpool School of Commerce.

Governance. Maintained; Liverpool Education Authority.

Students. 160 Full-time Senior. nil Junior.
554 Part-time Day Release. 117 Other Part-time Day.
3,103 Evening. nil Research.
nil Post Advanced/Graduate Courses.
3,934 Total Individual Students.

Teaching Staff. 23 Full-time. 10 Part-time Day. 133 Evening.

Departments. Commerce and Administration; Professional Studies; Languages.

Other Sections of Work. None.

Standard and Range of Courses

University of London External Degrees: B.A., B.Com., B.Sc. (Econ.) LL.B. University Diploma in Public Administration, and in Social Studies. Associate Membership/Associateship of professional institutions: Institute of Bankers; Chartered Institute of Secretaries; Institute of Chartered Accountants; Society of Incorporated Accountants and Auditors; Association of Certified and Corporate Accountants; Institute of Transport; Royal Institute of Chartered Surveyors; Auctioneers' Institute; Library Association; Final Diploma in Management Studies; Diploma in Municipal Administration.

General Statement

The foregoing courses are run in close collaboration with the respective professional associations or institutions. Many languages are taught to a high standard, e.g. French, German, Spanish, Italian, Russian, Danish, Dutch, Norwegian, Swedish, Portuguese and Irish Gaelic as well as in English for foreigners. There are flourishing Language Circles in French, German, Italian and Spanish, the last named publishing *El Clarin*, a periodical of high reputation.

The present premises were opened in 1931 and an extension was added in 1952 to meet the expansion in work from an average enrolment of 1,350 students in pre-war days to nearly 4,000 to-day.

LEEDS COLLEGE OF TECHNOLOGY

Date Established. Initially 1824. In present form 1937.

Previous Names of the Institution. Leeds Mechanics Institute (1824–68).
Leeds School of Science (1868–96).
Leeds Technical School (1896–1927).
Leeds Technical College (1927–37).

Governance. Maintained; Leeds Education Committee.

Students. 227 Full-time Senior. nil Junior.
2,759 Part-time Day Release. 80 Other Part-time Day.
3,066 Evening. nil Research.
27 Post Advanced/Graduate Courses.
6,122 Total Individual Students.

Teaching Staff. 75 Full-time. 11 Part-time Day. 367 Evening.

Departments. Mechanical Engineering; Building; Electrical Engineering and Physics; Chemistry and Biology; Mathematics; Food Technology; Printing and Photography; Clothing Technology.

Other Sections of Work. None.

Standard and Range of Courses

London University Degrees (External): B.Sc. Special Chemistry. B.Sc. (Eng.). B.Sc. (Gen.). A.R.I.C. Higher National Diploma in Building. Higher National Diploma (Sandwich) in Mechanical and Electrical Engineering respectively. College Diploma courses in Printing, Dress Design and Garment Construction. General Clothing Technology. Hotel Catering. National Diploma Course in Bakery. Higher and Post Higher National Certificate courses in Mechanical Engineering, Electrical Engineering, Building and Chemistry. Various special post graduate courses are offered each year.

General Statement

The College functions on a regional basis, nearly one-third of its students attending from a wide area outside the City. Joint Courses are arranged with the separate Colleges of Art and of Commerce. The total student population of the three institutions is over 12,000.

The College is recognised as a gauge-testing centre by the National Physical Laboratory. It is also affiliated to the University of Leeds for the B.Com. degree in which Printing Technology, taken in the College, may be offered as a principal subject in the final degree examination. At present the educational activities of the College are performed in a number of buildings, some remote from the main block, but work is already in progress on the erection of the first phase of the new building, situated in the centre of the City.

CARDIFF COLLEGE OF TECHNOLOGY AND COMMERCE

Date Established. Initially 1865. In present form 1916.

Previous Names of the Institution. 1865. Cardiff Science and Art School.
1890. Cardiff Technical School.
1916. Cardiff Technical College.
1950. Cardiff College of Technology and Commerce.

Governance. Maintained; Cardiff Local Education Authority.

Students. 1,025 Full-time Senior. 31 Junior.
1,282 Part-time Day Release. 28 Other Part-time Day.
4,480 Evening. nil Research.
30 Post Advanced/Graduate Courses.

6,876 Total Individual Students.

Teaching Staff. 96 Full-time. 28 Part-time Day. 212 Evening.

Departments. Architecture; Bakery and Catering; Building; Chemistry; Commerce; Engineering; English and Adult Studies; Mathematics; Navigation; Pharmacy; Physics and Electrical Engineering.

Other Sections of Work. Biology; Domestic Arts; Ophthalmic Optics.

Standard and Range of Courses

University of London: B.Sc. (Eng.) and LL.B. B.Sc. (Spec. Chem.). B.Sc. (Gen.). University of Wales: B.Arch. and B.Pharm. A.R.I.C., A.R.I.B.A., A.Inst.P. Commercial professional Institutions; Accountancy, Secretaries, Industrial Administration. Ordinary and/or Higher National Diplomas in Bakery, Building, Mechanical Engineering. Higher National Certificates in Building, Chemistry, Commerce, Electrical and Mechanical Engineering, Physics. Diplomas in Public Administration. Ministry of Transport Certificates in Engineering and Navigation. Pharmaceutical Chemistry.

General Statement

The only College of Technology in Wales, it draws its students from a wide area and 75% of the full-time students come from outside Cardiff —from other parts of Wales, England and overseas. For subjects such as architecture, navigation, optics and pharmacy it provides the only full-time Final courses in the Principality. The degrees in architecture and pharmacy are the internal degrees of the University of Wales, the College having been recognised by the University for this work since 1937. Certain advanced courses are recognised for increased grant under Circular 255 (pp. 471, 607).

Recognised for many years as the centre for advanced full-time work in Wales, this position is being further developed by the removal of all junior part-time work (to S.2 level) to a new Junior College, whilst the last of the junior schools ends in 1954.

SCOTTISH COLLEGE OF COMMERCE, GLASGOW

Date Established. Initially 1845. In present form 1903.

GLASGOW AND WEST OF SCOTLAND COMMERCIAL COLLEGE

Previous Names of the Institution. Glasgow Commercial College.
Glasgow Athenaeum Commercial College.

Governance. Central; Direct Grant.

Students. 679 Full-time Senior. nil Junior.
126 Part-time Day Release. nil Other Part-time Day.
3,022 Evening. 2 Research.
nil Post Advanced/Graduate Courses.
3,829 Total Individual Students.

Teaching Staff. 48 Full-time. 8 Part-time Day. 162 Evening.

Departments. Business Administration; Accountancy; Professional Studies; Modern Languages; Secretarial Science.

Other Sections of Work. Scottish School of Librarianship. Scottish Hotel School, Ross Hall, Glasgow, S.W.2.

Standard and Range of Courses

Full-time Diploma Courses (Three-Year) and Associateship Courses (Four-Year). (Recognised in Scottish Education Department as equivalent to a Pass (Three-Year) or Honours (Four-Year) of a University.) London University External B.A. and B.Sc.(Econ.) Degree Courses. Professional Courses (Full-time and Part-time) in Accountancy, Company Secretarial Work, Banking, Transport, Insurance, Shipping, Exporting, etc.

General Statement

The College functions as the Regional Commercial College for Glasgow and the West of Scotland and 60% of its students normally reside outside the City. For some of its courses, for the Scottish School of Librarianship and the Scottish Hotel School students come from all parts of Scotland and from abroad. There is close collaboration with industry and also with the Royal Technical College, Glasgow, as in the one-year Personnel Management Course.

HERIOT-WATT COLLEGE, EDINBURGH

Date Established. Initially 1821. In present form 1928.

Previous Names of the Institution. 1821. School of Arts.
1852. Watt Institution and Edinburgh School of Arts.

Governance. 1885–1927. George Heriot's Trust.
1928 to date—Central Grant.

Students. 420 Full-time Senior. nil Junior.
496 Part-time Day Release. 228 Other Part-time Day.
2,892 Evening. 4 Research. 1 Post Advanced/Graduate Course.
4,041 Total Individual Students.

Teaching Staff. 57 Full-time. 16 Part-time Day. 159 Evening.

Departments. Mechanical Engineering; Electrical Engineering; Civil Engineering; Mining Engineering; Chemistry; Brewing and Industrial Fermentation; Pharmacy; Physics; Mathematics; Building; Printing.

Other Sections of Work. Optics (in Physics Department); Gas Manufacture; Management Studies; Commerce (Evening Classes only).

Standard and Range of Courses

Internal B.Sc. Degrees of Edinburgh University and External Degrees of London University: Chemistry, Physics, Mathematics, Botany, Zoology, Engineering, Mining. A.R.I.C. Higher National Certificates in Mechanical Engineering, Electrical Engineering, Building, Chemistry. The College Associateships in Mechanical Engineering, Electrical Engineering, Civil Engineering, Mining Engineering, Applied Chemistry and Brewing are recognised by the respective Professional Institutions as exempting from their Associate Membership Examinations. Courses are held for commercial professional institution examinations.

General Statement

The College functions as a regional institution and is a recognised central institution (p. 606). Certain courses are recognised by the University of Edinburgh for the award of internal degrees, and the College collaborates with the Edinburgh College of Art in a complete scheme for the training of architects.

In 1935 the College took over the work of the Royal Public Dispensary, School of Pharmacy (Duncan's) and this Department, housed in a new building and very adequately equipped, attracts students from a wide area, including the North of England, seeking professional qualifications.

Completion of the Third and Final Section of the College Extension Scheme, commenced in 1933 and held up during the war and difficult post-war periods, is expected in 1956. The cost is estimated at £350,000. This building, when completed, will provide an assembly hall, a range of laboratories for chemical engineering, chemistry, physics, building, new drawing offices and lecture theatres. A new Chair in Chemical Engineering has really been established.

THE TECHNICAL COLLEGE, SUNDERLAND

Date Established. Initially 1901. In present form September, 1953.

Previous Names of the Institution. No change.

Governance. Maintained; Sunderland Local Education Authority.

Students. 554 Full-time Senior. nil Junior.
892 Part-time Day Release. 38 Other Part-time Day.
2,211 Evening. 1 Research.
nil Post Advanced/Graduate Courses.
3,668 Total Individual Students.

Teaching Staff. 70 Full-time. 23 Part-time Day. 241 Evening.

Departments. Mechanical and Civil Engineering; Electrical Engineering; Mining; Building; Pharmacy; Chemistry and Biology; Physics; Mathematics and Mechanics; Naval Architecture; Commerce; Housecrafts.

Other Sections of Work. None.

Standard and Range of Courses

B.Sc. Degree Courses in Applied Science, Pure Science and Pharmacy. Higher National Diploma Courses in Building, Electrical Engineering and Mechanical Engineering. College Diploma in Naval Architecture. Course for A.R.I.C. Pharmaceutical Chemists' Diploma. Higher National Certificate Courses in Building, Engineering, Mining, Naval Architecture and Applied Physics.

General Statement

The Sunderland Technical College was opened in 1901 to provide higher education in such sciences as have application in building, engineering, mining and shipbuilding. To achieve this object diploma courses, run on the 'sandwich' system—six months in college and six months in industry, over a period of four years—were commenced in 1903.

In 1930 the College was affiliated to the University of Durham in the Schools of Engineering so that students can now proceed through a three-year course of instruction for the internal degree of Durham University. Certain advanced courses are recognised for increased grant under Circular 255 (pp. 471, 607).

The College has an active Students' Union which provides for a wide range of social and sporting interests.

MANCHESTER MUNICIPAL COLLEGE OF TECHNOLOGY

Date Established. Initially 1824. In present form 1918.

Previous Names of the Institution.
1824. Manchester Mechanics Institute.
1883. Manchester Technical School.
1902. Manchester School of Technology.

Governance. Maintained; Manchester L.E.A., but also in respect of courses as Faculty of Technology of the University of Manchester (established 1905) receives direct grant from Universities Grants Committee. For impending changes see below.

Students. Full-time Senior. 670 University. 226 Vocational.
896 Total. nil Junior. 894 Part-time Day Release.
453 Other Part-time Day. 4,745 Evening.
152 Research (included in 896 above).
1,107 Post Advanced/Graduate Courses.
6,988 Total Individual Students.

Teaching Staff. 173 Full-time. 634 Part-time.

Departments. Mechanical Engineering; Electrical Engineering; Municipal Engineering; Applied Chemistry; Textile Industries; Building; Applied Physics; Mathematics; Industrial Administration; Printing and Photographic Technology; Textile Chemistry.

Other Sections of Work. Bakery; Applied Optics.

Standard and Range of Courses

The University Courses lead to the University of Manchester degrees of Ph.D., M.Sc.Tech., B.Sc.Tech., to the University Certificate in Technology, University Diploma in Chemical Engineering, University

Certificate in Industrial Administration. Full-time Non-University Courses to Higher National Diplomas and F.L.A. and Part-time Courses to the Associateship of the College and Higher National Certificates.

General Statement

For long the premier regional technical college in the North-west of England, the college has now become an institution of national rank. This is shown by its students coming from all over the British Isles and from many countries overseas, and also by the large proportion of research which is conducted in its laboratories and workshops. Its national status as a university institution is to be assured by a new corporate governing body with finance mainly derived through the University Grants Committee, while its undergraduate students will continue to gain Manchester University degrees under its new status as an independent college within the University. A very large extension costing over £2,000,000 is nearing completion and when available in 1956 will more than double the size of the College. Much non-university work is being transferred to other colleges and big developments on university lines are planned in chemical engineering, textile chemistry, industrial biochemistry, printing technology and in varying degrees in all other major departments.

BIRMINGHAM COLLEGE OF TECHNOLOGY

Date Established. Initially 1895. In present form 1947.

Previous Names of the Institution. Birmingham Municipal Technical School.
Birmingham Central Technical College.

Governance. Maintained; Birmingham Local Education Authority. Governing Body of 20 members; 5 Local Education Authority members, 15 representative of education, industry, professional and trade associations and the university.

Students. 453 Full-time Senior. nil Junior.
4,453 Part-time Day Release. nil Other Part-time Day.
3,124 Evening. 9 Research.
519 Post Advanced/Graduate Courses.
8,549 Total Individual Students.

Teaching Staff. 157 Full-time. 84 Part-time Day. 300 Evening.

Departments. Physics and Mathematics; Mechanical and Production Engineering; Electrical Engineering; Building and Civil Engineering; Metallurgy; Chemistry (Plastics Technology, Paint Technology and Gas Engineering); Industrial Administration; Pharmacy and Biology; Bakery and Catering; Domestic Science.

Standard and Range of Courses

The College Associateship (A.C.T.Birm.) is awarded in 19 branches of Science and Technology. The courses extend to a minimum of one year post-Higher National Certificate. London University External Degree Courses (B.Sc.) cover 8 branches of Science and Technology. Higher National Diploma Courses in Engineering and Building. Higher National Certificate Courses in 11 branches of Science and Technology. Courses for professional qualifications in various branches of Engineering

Science, in Pharmacy and Ophthalmic Optics. Four-year Sandwich Courses are now being offered in Mechanical Engineering, Electrical Engineering and Production Engineering; Courses for Final Certificates of the City and Guilds of London Institute in 34 branches of study. Courses in Management Studies for all levels of responsibility and the College awards its own certificates and diploma in industrial Administration. Certain advanced courses are recognised for increased grant under Circular 255 (pp. 471, 607).

General Statement

The college functions as a regional College of Technology and since 1948 it has been transferring S.1 and S.2 classes to contributory colleges, of which there are now four in Birmingham. Arrangements are now being made to shed S.3 classes but, at the same time, a limited intake of selected students with special G.C.E. entry qualifications are being admitted direct to part-time day five-year courses in mechanical, production and electrical engineering leading to the Associateship of the College and any other appropriate academic and professional award. Four-year sandwich courses for selected apprentices began in session 1954–5.

Research work on about 30 projects is being actively conducted. Some 30 members of the teaching staff and nine research assistants are engaged in this work. Research contracts have been placed by Government Departments and Industry. The college has thirteen Advisory Committees.

The new college, costing about £2,000,000, which is being built in sections, will have the first section ready for occupation in the near future.

STRETFORD TECHNICAL COLLEGE

Date Established. Initially 1899. In present form 1939.

Previous Name of the Institution. Old Trafford Technical Institute.

Governance. Maintained; 'Excepted' Division of Lancashire.

Students. 45 Full-time Senior. 290 Junior.
1,475 Part-time Day Release. 80 Other Part-time Day.
1,290 Evening. nil Research.
nil Post Advanced/Graduate Courses.
3,180 Total Individual Students.

Teaching Staff. 35 Full-time. 10 Part-time Day. 75 Evening.

Departments. Mechanical Engineering; Electrical Engineering.

Other Sections of Work. Science; Trades; Commerce; Domestic.

Standard and Range of Courses

Ordinary National Certificate in Mechanical Engineering, Electrical Engineering, Chemistry, Commerce, C. and G. Final and Post C. and G. Courses in engineering trades.

General Statement

Stretford is situated in a highly industrialised area, for the greater part of Trafford Park lies within the Borough. The College growth has naturally been associated with the industrial development of the locality and Engineering and Science Courses predominate. The College building, directly opposite to the Old Trafford Cricket Ground, was completed in 1939 and has an assembly hall, gymnasium, library, refectory and adjacent playing field. Over 150 Ordinary National Certificate awards are gained annually, including about 55 each in mechanical and electrical engineering and over 40 in chemistry, and students usually proceed to the Royal Technical College, Salford, for advanced courses. Great attention is devoted to the development of Trades' Courses and there are over 650 students in these courses. Post City and Guilds Courses have been introduced in production and automobile engineering and gas supply.

THE POLYTECHNIC, REGENT STREET, LONDON, W.1

Date Established. Initially 1863. In present form 1882.

Previous Names of the Institution. The Polytechnic Young Men's Christian Institute.

Governance. Administered on behalf of the Charity Commissioners by a Governing Body appointed and acting in accordance with schemes made under the City of London Parochial Charities Act, 1883. The Polytechnic is financially aided by the London County Council, the City Parochial Foundation and private donation.

Students. 1,722 Full-time Senior. nil Junior.
494 Part-time Day Release.
601 Other Part-time Day. 10,376 Evening.
2 Full-time } Research.
5 Part-time } Research.
188 Post Advanced/Graduate Courses.

Members. 5,052 Social and Athletic Clubs.
18,440 Total Individual Students.

Teaching Staff. 155 Full-time. 72 Part-time Day. 486 Evening.

Departments. Architecture; Surveying and Building; Commerce; Art; Chemistry and Biology; Mathematics and Physics; Languages; Domestic Science; Management Studies; Photography; Preliminary Professional; Physical Education (men); Physical Education (women).

Other Sections of Work. Journalism; Motor Body Engineering.

Standard and Range of Courses

London University Degrees (External) (General and Special) in Biology; Chemistry; Economics; Engineering; Mathematics and Physics. Final Professional Examinations in Accountancy; Architecture; Building; Cost and Works Accountancy; Export; Industrial Administration; Photography; Public Administration; Sales Management; Secretarial Practice; Surveying; Town Planning. Teachers' Diplomas and Certificates in Domestic Subjects. Higher National Diplomas and Certificates in Building, Design, Engineering (Civil, Electrical and Mechanical) and Management Studies.

General Statement

The Polytechnic is distinguished from most other institutions for further education in making provision for both students and members. The latter can join its many athletic, social and spiritual activities without the obligation of academic studies. The athletic clubs are particularly strong and figure largely in international and national records.

The spiritual activities, forming the basis on which the work of The Polytechnic was founded by Quintin Hogg, have continued to the present day.

On the academic side The Polytechnic occupies a prominent place in the regional arrangements for London and the Home Counties. By reason of its location and past record it has become a centre for the conduct of advanced day and evening classes and in recent years most of its craft courses have given place to professional courses at high level. Certain advanced courses are recognised for increased grant under Circular 255 (pp. 471, 607).

NORTHAMPTON POLYTECHNIC, LONDON, E.C.1

Date Established. Initially 1891 (opened 1896). In present form 1903.

Previous Names of the Institution. Northampton Institute, being one of three forming the 'City Polytechnic' (dissolved 1907).

Governance. Administered on behalf of the Charity Commissioners by a Governing Body appointed and acting in accordance with schemes made under the City of London Parochial Charities Act, 1883. The Polytechnic is financially aided by the London County Council, the City Parochial Foundation and private donation. Independent Governing Body of 20 plus Marquess of Northampton.

Students. 388 Full-time Senior. nil Junior.
1,709 Part-time Day Release. 28 Other Part-time Day.
3,043* Evening. 1 Research.
997 Post Advanced/Graduate Courses.
155 Short Special Day Courses.

*Includes 997 at Post Advanced Courses.

5,314 Total Individual Students.

Teaching Staff. 100 Full-time. 6 Part-time Day. 200 Evening.

Departments. Civil and Mechanical Engineering; Electrical Engineering; Mathematics; Applied Physics; Applied Chemistry; Ophthalmic Optics.

Other Sections of Work. Production Engineering; Instrument Engineering; Watch and Clock Repair Work.

Standard and Range of Courses

London B.Sc. (Engineering) Internal Degree. Higher National Certificates in Mechanical, Electrical, Civil, Production, Aeronautical and Instrument Engineering, Applied Chemistry, Applied Physics. Professional Optical examinations (F.S.M.C., F.B.O.A., F.A.D.O.). Final City and Guilds Examinations in twelve distinct courses; Engineering, Telecommunications, Applied Chemistry, etc. Examinations of British Horological Institute and Institution of Municipal Engineers.

General Statement

The Polytechnic has the status of an Institution of the University of London with Recognised Teachers. The full-time Engineering course leads to Polytechnic Diploma and Internal Degree and includes vacation works periods. Certain advanced courses are recognised for increased grant under Circular 255 (pp. 471, 607).

The Ophthalmic Optics course leads to Diploma and professional qualifications, in which the enrolment exceeds the other centres altogether.

The Polytechnic accommodates National College of Horology and Instrument Technology, Institute of Metal Finishing founded in Chemistry Department, 1925. Buildings founded 1894, extended 1909, 1939, 1942, 1949 and 1952–5. Amenities include library, refectory (400), great hall (organ), swimming bath, playing fields (fourteen acres), tennis courts.

Northampton Polytechnic is one of nine London Polytechnics founded 'for the social, recreative and educational benefit of the poorer classes'. While an early document suggests 'the institute should be a happy species of club for men and women students' its scheme of instruction covered art, science, technology, manual training, domestic economy, commerce, languages, law, medicine, music, athletics and excursions. With the passing years the social and recreational activities have diminished and the original wide scope of instruction has narrowed, leaving mainly engineering together with chemistry, physics, mathematics, horology and ophthalmic optics. During the same period the catchment area has altered from the immediate Finsbury neighbourhood to that of a regional college of the Greater London Area.

BARRETT STREET TECHNICAL COLLEGE, OXFORD STREET, LONDON, W.1

Date Established. Initially 1915. In present form 1949.

Previous Name of the Institution. Barrett Street Trade School for Girls. Barrett Street Technical Institute.

Governance. Maintained; London County Council.

Students. 515 Full-time Senior. nil Junior.
121 Part-time Day Release. nil Other Part-time Day.
1,563 Evening. nil Research.
nil Post Advanced/Graduate Courses.
1,797 Total Individual Students.

Teaching Staff. 42 Full-time. 13 Part-time Day. 33 Evening.

Departments. Dressmaking; Hairdressing; Design (including Millinery, Artificial Flower-Making); Academic.

Other Sections of Work. Tailoring; Embroidery; Furriery.

Standard and Range of Courses

City and Guilds Full Technological Certificate in Tailoring. City and Guilds Certificate in Hairdressing—Course recognised as equivalent of full apprenticeship.

General Statement

The London County Council opened Barrett Street Trade School in 1915 to train a small group of 13-year-old girls in a needle-trade or hairdressing. By 1928 an extension of the building was opened, and senior departments in dressmaking, ladies' tailoring, hairdressing and embroidery came into being, training junior and senior students in the day and workers from the industries in the evening. Since the 1945 Act, the Secondary School has ceased to exist, departments of furriery and ladies' and men's hairdressing and tailoring have been transferred from other colleges, and a millinery department added, in order to concentrate the training for the clothing and hairdressing trades in the one organisation, Barrett Street Technical College. The College is now housed in four separate buildings.

The full-time day courses are usually two years' duration and include subjects of general education. Few public examinations are held in these subjects, but students are prepared for City and Guilds Tailoring and Hairdressing examinations; other satisfactory students receive a college certificate and students come from all parts of the British Isles and from overseas.

LONDON SCHOOL OF PRINTING AND GRAPHIC ARTS

Date Established. Initially 1894. In present form 1949.

Previous Names of the Institution. London School of Printing and Kindred Trades. L.C.C. School of Photoengraving and Lithography.

Governance. Maintained; London County Council.

Students. 265 Full-time Senior. nil junior.
3,063 Part-time Day Release. nil Other Part-time Day.
2,938 Evening. nil Research.
nil Post Advanced/Graduate Courses.
6,266 Total Individual Students.

Teaching Staff. 90 Full-time. 45 Part-time Day. 166 Evening.

Departments. Design; Administrative Subjects; Science and General Education; Photographic Processes; Composing; Letterpress and Foundry; Lithographic Printing; Bookbinding.

Standard and Range of Courses

Ministry of Education: National Diploma in Design. Diploma in Management Studies. City and Guilds: Full courses in fourteen subjects—up to Full Technological Certificate where available. British Federation of Master Printers: Costing and Estimating. School Diploma: Full-time course in Printing Technology and Management.

General Statement

The present school was formed by the amalgamation in 1949 of two schools which were started by the industry in 1893 and 1894 and were taken over by the London County Council in 1912 and 1922. Outstanding features are: Comprehensive whole-time courses in printing technology to which students come from all over the world, highly developed co-operation with industry for day-release courses, essentially practical teaching of Commercial Design because of availability of all methods of printing reproduction and flow of senior students from all technical departments into B.I.M. Course in Management Studies. (p. 371).

LONDON COUNTY COUNCIL BRIXTON SCHOOL OF BUILDING

Date Established. 1904. In present form 1928.

Previous Names of the Institution. L.C.C. School of Building.
The word BRIXTON was inserted when L.C.C. Hammersmith School of Building was established in 1928.

Governance. Maintained; Governing Body appointed by L.C.C. and representing all sections of the building industry and associated professions.

Students. 251 Full-time Senior. 353 Junior.
1,047 Part-time Day Release. nil Other Part-time Day.
1,930 Evening. nil Research.
nil Post Advanced/Post Graduate Courses.

3,581 Total Individual Students.

Teaching Staff. 80 Full-time. 35 Part-time Day. 215 Evening.

Departments. Building and Structural Engineering; Architecture and Surveying; Building Trades; Art; Secondary Technical School.

Standard and Range of Courses

Higher National Diploma (Building), Higher National Certificate (Building and Civil Engineering). National Diploma of Design. A.I.O.B., A.M.I.C.E., A.M.I.Struct.E., A.R.I.B.A., A.R.I.C.S., A.I.B.D. Full range of building craft courses including Post-Final City and Guilds Courses in building subjects. Managerial and Foremanship studies related to building. Special Post-advanced courses of technical studies.

General Statement

This College was the prototype for monotechnics concerned with building and by 1914 was well known for its advanced evening studies and its Junior Technical School. Organisation and development of its courses of study have kept pace with corresponding changes in technical education as a whole and the College now provides a full range of courses related to building and the associated professions. Although the Junior School is still within the College, it is expected to be separated in new premises in 1956.

Since 1945 new developments have included management and foremanship studies related to building, special courses dealing with new constructional techniques, sandwich courses with entry at G.C.E. Advanced level and application of the combined resources of a monotechnic to building research. Certain advanced building and structural engineering courses are recognised for increased grant under Circular 255 (pp. 471, 607).

LOUGHBOROUGH COLLEGE OF TECHNOLOGY

Date Established. Initially 1909. In present form 1st September, 1952.

Previous Names of the Institution. Loughborough Technical Institute.
Loughborough Technical College.
Loughborough College.

Governance. Direct Grant. Governing Body appointed by Minister and includes some L.E.A. representatives.

Students. 768 Full-time Senior. nil Junior.
nil Part-time Day Release. nil Other Part-time Day.
nil Evening. nil Research.
20 Post Advanced/Graduate Courses. Summer Chemical Engineering Course).

788 Total Individual Students.

Teaching Staff. 85 Full-time. 2 Part-time Day. nil Evening.

Departments. Mechanical and Civil Engineering; Electrical Engineering; Science and Chemical Engineering; Automobile and Aeronautical Engineering; Works Department.

Other Sections of Work. None.

Standard and Range of Courses

Four-year courses with entry standard of General Certificate of Education, advanced level in mathematics, physics and chemistry, are held in mechanical, civil, electrical, automobile, aeronautical and chemical engineering, and industrial chemistry, but provision is made for one preliminary year for other suitable students. The College Diploma at the Pass and Honours levels is awarded in all undergraduate courses, and students who fulfil London University entrance requirements take the External Degree of that University. A one-year and short summer post-graduate courses in chemical engineering, are held for graduates in either engineering or chemistry.

General Statement

Alternate weeks are spent in the College workshops and in the lecture rooms and laboratories. The College workshops are organised for productive work, the students being engaged on production whilst undergoing practical training during forty-hour week. The majority of the products consist of specially designed apparatus for use in universities and colleges, but sub-contracting work is accepted from industrial concerns.

More than 95% of the students are accommodated in halls of residence or registered lodgings. (At present there is hostel accommodation for 290 students but this capacity is being increased.)

The playing fields extend over more than 120 acres. There are outdoor and indoor swimming pools and gymnasia providing indoor facilities in tennis, badminton, cricket, basketball and similar activities, and also facilities for social and similar clubs and societies. Approximately 40% of the students come from Commonwealth or foreign countries. The facilities for corporate life are shared with the Loughborough Teacher Training College which was formerly part of Loughborough College.

The work of the College of Technology is being centralised in a newly erected building situated on the playing fields, near to the two largest hostels, and further additional buildings will be erected later.

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2. L. J. Corbett, General Manager, Wales and Monmouthshire Industrial Estates Ltd., articles in the *Western Mail*, February–March, 1952.
3. *Technics and Civilisation*, Lewis Mumford, p. 109 (1934 edition, Harcourt Brace & Co.).
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CHAPTER III

GENERAL WORKING ARRANGEMENTS AND COURSES (MOSTLY FULL-TIME)

From the local and national scene we now turn to look inwards and consider the courses and general working arrangements of the institutions themselves. A more detailed account of each kind of course, craft and technology will be found in the later specialist chapters: here the purpose is to present the way in which courses are arranged, the factors which determine their success, something of their content and standards, something too of the problems which have to be faced in the task of welding what might be merely a great agglomeration of diverse groups into a living educational institution.

If we visit a college at various times of the day we shall encounter a large and varied group of students surging through the doors, coming with a surprising eagerness and air of purpose—surprising, that is, considering what is said so often to the detriment of this generation, but not surprising when one reflects that by far the greater part are attending their courses voluntarily. At the beginning of the morning, usually about 9 a.m. we may meet senior full-time students ranging in age from 16 to 21 years or more, together with part-time day students from industry, of both sexes and from a wide variety of occupations. There may also be, especially in the smaller college, pupils in school uniform attending junior art departments, secondary technical schools having engineering, building, commerce, domestic science courses and, often a little later—about 9.30 a.m.—and in some cases no less characteristically garbed, the senior students of the school of art. In the afternoon the diversity may be further increased by more part-time students with one or two half-day's release from industry instead of the usual one full day; there may come married women attending various courses related to the home or taking part in leisure activities while their children are at school. From time to time may be met those attending advisory committee meetings and even a governors' meeting *in situ* for the practice of meeting elsewhere (as in the Town Hall or Education Office) fortunately appears to be declining. Extra pressure on the all-too-limited car parking facilities may also indicate a regional conference of some professional, industrial or commercial organisation for its own purposes in this convenient centre, an act of hospitality on the part of the college almost certain to bear fruit in increased co-operation later in some form or another. And it is not only a question of convenience, for sometimes it is an advantage to meet on neutral ground. The prospectuses of the colleges provide numerous examples of learned and other societies meeting in them, some in the afternoon but mostly in the evening and at week-ends, for few colleges work only a five-day week.

Though perhaps most of the day students leave at the end of the afternoon, usually between 4.30–5 p.m., many stay on for teatime and evening classes and are to be seen in the college refectory or canteen. Here too will come many more direct from work for a brief break and some light refreshment before attending evening classes. Part-time day students will be staying on for an associated evening class on the generally accepted basis of 'one day plus one evening', but it is not always feasible or necessary to arrange the class on the same night, so various groups of such students attending on different days may meet together in this way. There will be full-time students and, more exceptionally, part-time students staying on for meetings of their societies. Teatime classes are arranged partly for lack of accommodation at normal times and partly to meet the travelling difficulties of students with far to travel afterwards. Such classes are a particular problem of regional colleges with students travelling 20 miles or more each way to attend advanced courses. As a solution they make but a doubtful virtue of necessity and other alternatives ought to be sought. In some cases full-time students stay on for evening work because the necessary conditions and equipment cannot reasonably be expected at home for home work and private study. Thus many students of art and architecture stay on to work in the studios and drawing offices as such facilities are not available at home: every influence should therefore be brought to bear to encourage societies and similar activities in the tea interval.

In the great majority of institutions evening classes preponderate over the rest of the work and the press of students coming into college between 6–6.30 p.m. is often most impressive and indeed exhilarating to see. They will probably be noticeably older, including very many beyond the age of full-time and even part-time day courses, many taking refresher and even post-graduate courses, many studying foremanship and high level management. Many others take adult education courses and participate in leisure activities (drama, music and the arts) and meetings of societies. The main age groupings are given in Table 7 [1].

TABLE 7

ANALYSIS OF AGE GROUPS IN COURSES
(England and Wales 1952–3)

(i) Major Establishments of Further Education

Course	14	15	16	17	18	19	20	21 and over	Total
Full-time day	2,681	9,903	10,242	6,981	5,016	4,208	3,511	13,939	56,481
Part-time day	10,673	58,360	74,066	64,082	32,797	23,062	17,062	72,947	353,049
Evening	9,410	50,308	84,836	80,185	56,423	46,621	38,945	425,938	772,666
TOTAL	22,764	118,571	169,144	151,248	94,236	73,891	59,518	512,824	1,182,196
(ii) Evening Institutes									
Evening	78,777	119,736	88,526	63,141	30,448	22,057	21,379	612,455	1,036,519

Individual colleges will differ considerably from the general picture as shown in Diagram 4A, and a regional college may expect to have a higher age grouping than one of its contributory colleges or a local technical college. This will be a potent factor in determining the character of an institution and the educational methods used in its work.

There are thus three main sections of work, full-time, part-time day and evening, which go to determine the character of the institution, but the relative volume of work in each, and the consequent balance of effect, will vary from one institution to another. This may be illustrated by typical work profiles of different types of college as in Diagram 4B.

These work profiles of actual colleges are only broadly illustrative, for the work of technical institutions is neither constant nor static for long periods. It changes markedly from day to day, both in volume and character. Moreover such a representation of work in terms of student-hours gives us a ready comparison of the relative number of students attending the various types of courses. For example, the College of Further Education represented has about 30 senior and 90 junior full-time students; about 800 part-time day students of whom some 560 are day-release students from industry; with about 2,280 students attending in the evenings. Full-time courses remain much the same from week to week but the part-time day load changes each day. A different release takes place from all the varied industries each day, either for

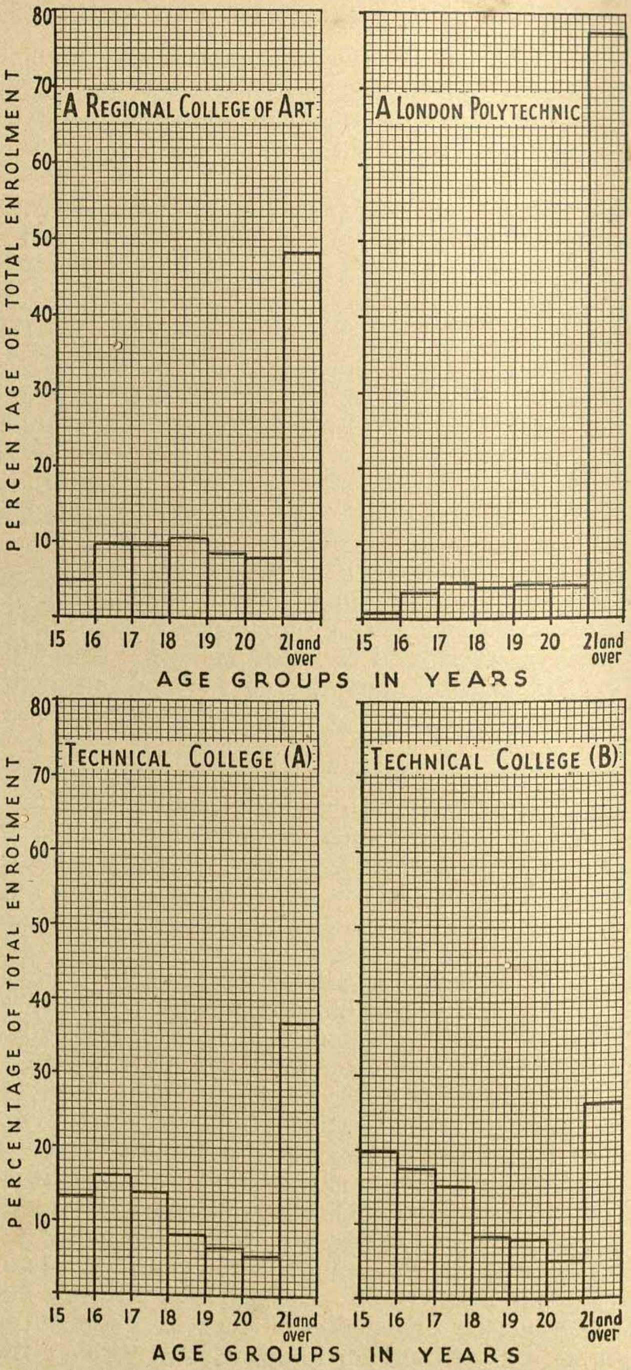

DIAGRAM 4A.

AGE ANALYSIS OF COLLEGE ENROLMENTS

a whole day or a half-day, or in some cases for final courses for an additional half-day or even two half-days. Again it is virtually impossible to secure release from some industries on certain days, e.g. no part-time day bakery classes are arranged on Fridays. The day release is also affected by the age structure of the firms and especially the number of apprentices at the same or different stages of training. Industry can hardly be expected to release all on one day for the benefit of the college and its own maximum inconvenience. The load must be spread and it is unlikely to be spread evenly, but investigation of a number of colleges shows no discernible pattern, probably because the colleges are full to capacity. Similarly, though there is an uneven distribution of enrolments in evening courses on the five nights Monday to Friday, there is again no clearly discernible pattern. These three sections of

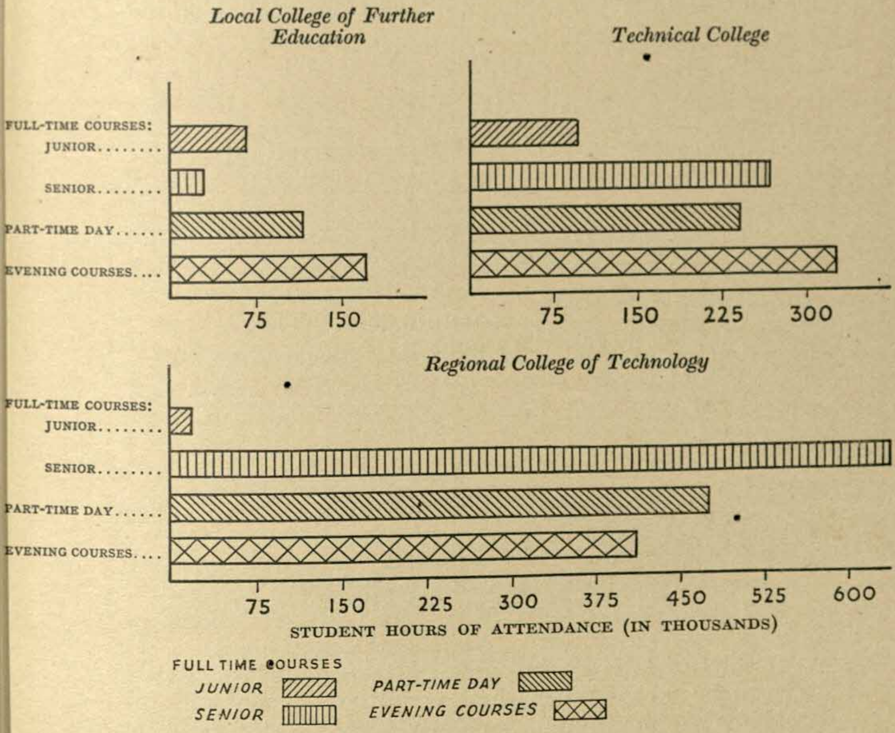

DIAGRAM 4B. WORK PROFILES OF COLLEGES
Full-time day, Part-time day and Evening Courses

college work, full-time day, part-time day and evening courses, interact as three interpenetrating phases, as represented in Diagram 5.

Diagram 5 is intended only to convey in the broadest terms what might be the relative volumes of work in a college and their impact on one another. Area (A) represents the undoubted impact of part-time day courses upon the full-time ones, which shows itself in demands for specialist accommodation and staff. Where enough of these are available, there is no conflict of interest, but only differing requirements which have to be met. When these conditions do not obtain the problems are acute and, generally speaking, the temptation is to shed part-time courses in favour of full-time ones or, at least, not to expand the part-time courses preferentially. It is much easier to arrange for a single full-time group throughout the week than four or five separate sections of day-release courses.

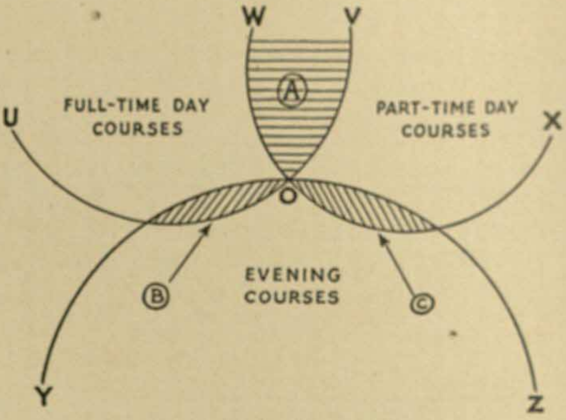

DIAGRAM 5. INTER-RELATION OF FULL-TIME DAY, PART-TIME DAY AND EVENING COURSES

The area within the curve UOV represents full-time day courses; WOX represents part-time day courses; YOZ represents evening courses. The shaded areas represent the actual or potential interaction between these three phases of college work.

There is the balance of interest of (say) 20 full-time students per annum as against 80–100 part-time students employed in industry, and for a three-year full-time course this means that some 55–60 students would exclude about 250 part-time students. In terms of the greatest good of the greatest number presumably the part-time students should be favoured and that not least in terms of working efficiency in industry. Viewed as long term policy on the ultimate effects in industry the output of 20 full-time students per annum may have a much greater value and this because of the investment of their broadly based and more scientific education. On the other hand, the college must garner good ability where it can and this it can hardly do effectively if it cuts off its roots in industry, namely, the part-time day release courses. This contention applies particularly to recruitment to sandwich courses, but the problem cannot be solved without adequate and suitable accommodation and the regional organisation of courses between major and local colleges.

Area B and Area C of Diagram 5 imply the interrelation of day-time and evening courses and this again is greatly influenced by total demands on accommodation. If these are great there is frequently a conflict of interest, for example, the necessary curtailment of classes and especially of work in studios and drawing offices because of tea-time classes and early evening classes. Another effect, not always readily discernible but serious in the long run, is that the cleaning and maintenance of rooms and equipment is greatly hindered if not sometimes entirely neglected. Areas A, B and C are subject to fluctuation from day to day and represent varying peak loads on accommodation, teaching staff, use of refectory, etc., which are not readily apparent from the simple enumeration of enrolments in a college. A central room timetable/schedule, preferably under the sole control of a senior member of staff, is vitally necessary to minimise difficulties at these inter-phases, especially with overcrowding.

Not only does this three-phase diagram alter from day to day but it, and also Diagram 4, alters from term to term. Sandwich courses have varying periods of industrial experience interwoven with study in college, but the most general pattern is six months from September to March in college and then the students return to industry (p. 86). The work profile will thus alter markedly from April or May onwards. Part-time day courses are of varying length, generally totalling some 230 hours in the year, and are usually determined by the requirements of approved courses, e.g. for National Certificates. The end of the course is usually determined by examinations, but this is not always so, when the post-examination period is apt to have teaching problems of its own. Most part-time day courses are completed by the end of June, but evening classes generally finish earlier—in late April or May. A trickle of professional classes may continue with September–October examinations beckoning gloomily throughout the summer to the unfortunate few, and there may be summer 'short-courses' in special techniques and technologies. As this load declines and if overall staffing permits, there will be renewed impetus to research and other work done for industry, at least in the major colleges. There is always a danger in providing a diagram as too much may be read into it, especially on a quantitative basis, but Diagram 6 is an attempt to picture the varying load of work and arrangements in a major college.

Of the general factors the primary one is relation to need and with it goes the problem of recruitment. The two are not the same; the need may be explicit or unrealised but even if it is fully acknowledged and an appropriate course has been drafted, the problem of securing a proper recruitment remains. Providing for an explicit need is a relatively simple matter though certain procedures are wise. An exploratory conference of interested parties should be called together to range over the problems involved, both from the industrial and college aspect, and a satisfactory working arrangement devised. This may be done through the College Advisory Committee as a whole, or through a sub-committee or an *ad hoc* panel drafted for the specific job (Chapter V). Neither side should adopt a bargaining attitude but should co-operate in clarifying the problem and providing a practicable solution. There is sometimes a tendency to regard such innovations as definite and complete, when they are mostly experiments the conclusion of which cannot be assured or determined in advance. Moreover, the experiment, co-operatively undertaken, may be the only way of deciding a controversy and may justifiably be undertaken for that reason only. Frequently the outcome is a surprisingly large enrolment, which may be due to a pent-up demand with lower enrolments in subsequent years. Initially the latter figure is often most difficult to determine and the exploratory committee and the principal should be spared the unhelpful attentions of those who dispense wisdom by hindsight. When the steady figure is determined it may fully justify a permanent course or it may require a course in parts on an annual cycle, e.g. 1953 Part A; 1954 Part B; 1955 Part A; or yet again require an intermittent course at two or more year intervals until the demand has risen to an effective level. This applies particularly to post-advanced courses at regional level.

An unexpectedly large enrolment can result because the course has touched off an unrealised need and this may lead

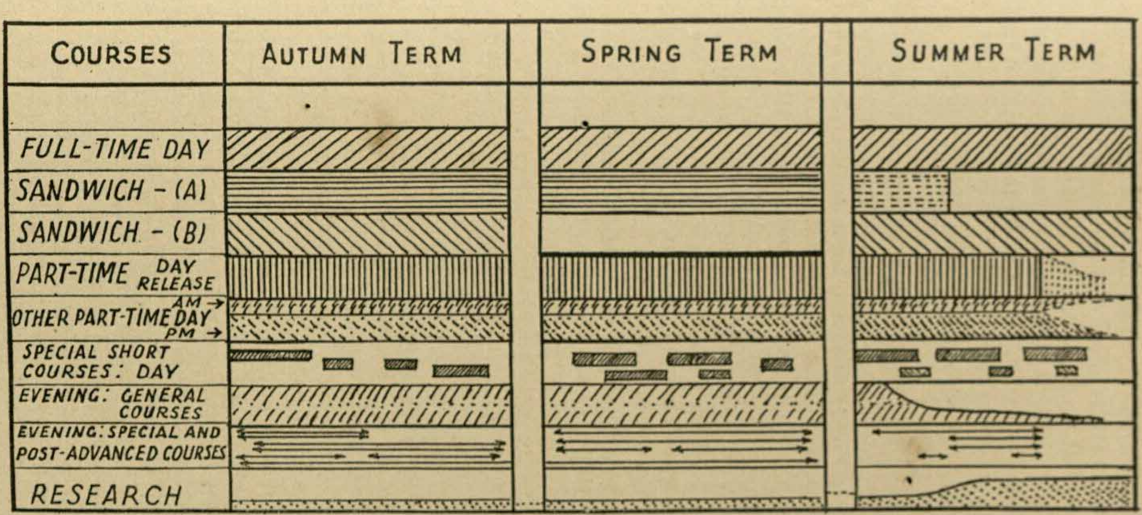

DIAGRAM 6. COLLEGE WORK PROFILE—TERM BY TERM

to a permanent course with steadily increasing enrolments. Those responsible for the college must realise that the situation is far more often one of supply and demand, not demand and supply. There is nothing exceptional in this as it runs throughout life: at no early stage were the public demands for cinema, radio, television, motor cars, synthetic fabrics, health services, higher education, as great as the faith and energy of those who originated them.

The response to supply is often unpredictable even for established courses. A college may have the same number of part-time students in each of two successive sessions but the make-up of courses may show substantial changes, some being duplicated or triplicated, some even lapsing altogether. For new courses the prospect is more uncertain still, and will vary according to their nature, whether they be vocational or general, educational or leisure activity, whether the students be school-leavers or adults. In times of stress and rising fees the vocational courses are the last to suffer, but none in technical education should regard this reduction of other work with equanimity.

Entry standards are important and should not be unrelated to the potential supply of students. Many a course has suffered by having its entry conditions set too high or, with an established course, having them raised abruptly because of rising demands of content or the final passing-out standards to be achieved. A hiatus is thus created, for example, between the school leaving age from the modern school and possible entry into a probationary nurses' training course; or yet again, by a sudden insistence on higher exemption standards for National Certificate Courses and thus denying entrance to students who formerly profited by the course without complying with such standards.

Nowadays it goes almost without saying that the essential conditions of success for a vocational course are that it should be clearly defined in purpose, progress in clearly defined stages and lead to an award (certificate or diploma) which is generally accepted in the students' industry or profession and if possible in the community at large (Chapter VI). The desire for awards has led to an almost bewildering variety of certificates —College Certificates of attendance at short courses, and of attainment in longer courses, College Ordinary and Higher Diplomas, Ordinary National and Higher National Certificates and Diplomas, Certificates of Examining Unions and Diplomas of Professional Institutions, not to mention Certificates of General or Preliminary Education, Advanced G.C.E., Intermediate Degree and Final Degree examinations. The desire and social pressure for professional status, or at least accredited status, is very strong, with results amusingly if not acridly depicted by R. Lewis and Angus Maude in their book *Professional People*. In speaking of possible upgrading to professional status they note as one condition

> An assortment of letters designate, for attachment to the names of those who feel aspiring enough to pay a few guineas subscription for them. We may yet see a Bill presented to Parliament for the establishment of a British Hairdressing Board, with compulsory registration of hairdressing technicians. In fact, many functions with only very little more intellectual content do pass themselves off as professional. Even so, in the fullness of time may Jno. Smith, Chimney Sweep, become John Smith, A.I.D.D. (Associate of the Institute of Domestic Decarbonisers) [2].

Or yet again, in dealing with qualifications at management level:

> Many of the management bodies speak as if their members enjoyed professional status already, and point to the wording of the report on Education for Management which brackets accountancy and engineering with 'those institutions offering a professional qualification in some aspect of management, e.g. Personnel Managers, Sales Managers. . . .' Few would, however, contend that this right to put behind one's name such combinations of letters as M.O.M.A., M.S.M.A., M.I.W.M., or M.I.Ex., carries quite the same glow of inward worth as the right to call oneself M.I.Mech.E., or C.A. [3].

Nevertheless it is easy to be too superior in these matters, and not a few have forgotten the incentives along the route by which they laboured to achieve competence and status. Many a student has set himself a limited objective only to 'raise his sights' on achieving it. Thus in time, with growing satisfaction and renewed endeavours, has come his Ordinary National Certificate after three years, Higher National Certificate after another two, endorsements in the year or two following with graduate standing in the Institution and then finally, full professional status a few years later—a status but dimly apprehended if at all understood when first he set out.

Other factors which determine the success of courses are staffing, buildings and equipment (Chapters XVIII, XIX), and the only other general factor is deferment from National Service granted to some students to enable them to complete training. National Service is an entirely novel factor in this country, introduced for the first time in peacetime in 1946–7, which might well have seriously affected many of our courses if not wrecked them. That this has not happened has been due to the wise and imaginative way in which the Ministry of Labour has drawn up its regulations and coped with the day to day human problems which arise however good the regulations may be. Far from being adverse in effect the regulations have had good educational effects and especially in stimulating and consolidating day-release from industry (Diagram 9). Some employers have granted day-release to retain valuable employees and some employees have been brought to realise the value of continued training and study both within industry and subsequently in the Services, and this has been the Government's intention [4].

Readers are referred to Mr. G. J. Nash's lucid paper [5] for a consideration of the principles and rules affecting the deferment of full-time and part-time students, articled pupils and others being trained for professional posts, including student engineering apprentices and other apprentices and learners. Heads of departments naturally make it their close concern to understand and keep up-to-date with the rules and with the different procedures so as to advise their students accordingly. At least one college, however, has found it desirable to designate a full-time member of staff as dealing 'with all questions of deferment from National Service' [6]. Not a few prospectuses carry the warning to students that though the college staff will advise them, students remain responsible for securing their own deferment. Each deferment is of course subject to satisfactory attendance and progress being made by the student.

Full-time courses ranking for deferment may be classified as of 'Joint Recruiting Board' standard or below. The former include degree courses and Higher National Diploma Courses with implications regarding the standards of the latter not generally appreciated by the schools or by parents. Deferment is safeguarded for the student transferring from a part-time course to a full-time or sandwich course and for a degree student wishing to gain two years' industrial experience after graduation. Similarly a physics graduate may have two years' practical training to qualify as an electrical engineer. Such flexibility of arrangements and training within the overall principles laid down is most desirable.

Deferment for part-time students, apprentices and articled pupils is not granted to enable them to sit an examination but to pursue a course of training for a professional qualification, which does not merely imply employment plus classes.

There must be a substantial element of training in the arrangements between the employer and employee and for this reason the Ministry of Labour insist on the employer allowing time off from work for study for eight hours a week on the average. Commercial students attending courses for the National Certificate in Commerce are not deferred and this has been a continuing sore point with the commercial colleges and departments [5*a*]. The O.N.C. and H.N.C. in Commerce are not linked with the professional institutions as in engineering and, moreover, are still in their very early stages. If recognition could be secured enrolments would increase and deferment probably follow; if deferment is refused enrolments are small and it is more difficult to secure recognition.

All in all, deferment regulations have been well administered to the general good of students and industry and incidentally of the colleges. The effect has been to raise the general age range of part-time day students in attendance.

Before we consider the full-time, part-time day and evening courses more closely, their relative proportion and age structure should be emphasised. These are shown in Table 8 which is an expanded form of Table 1.

Continued education is very largely part-time day and evening in character, and altogether disproportionately so for modern needs. The percentages given in line 23 of Table 8 are optimistic in that they are based on enrolments and not on continued average attendance throughout the session (Table 13). No people passionately concerned about education could long accept the realities of lines 8, 12, 22 and, above all, line 24.

The proportion of young people who cease to have any continued education in organised courses is 29·76% at 15 years, 39·57% at 16 years, 54·54% for the 17-year-olds and 78·25% for those aged 18 to 20 (excepting such education and training as is given in H.M. Forces). These are optimistic figures based on actual enrolments, not on continued average attendance, which is much less encouraging (Table 13).

Full-time Courses

These are of widely varying duration and standards. Some are courses of one year or two years in general education, for example, for the General Certificate of Education (G.C.E.) at Ordinary and Advanced Levels. Strictly speaking these belong to the secondary stage of education but these and similar courses have been part of the work of technical institutions for many years. In the past many students, through

TABLE 8

ANALYSIS OF AGE GROUPS (15 TO 20 YEARS) IN SCHOOL, COLLEGE, EVENING INSTITUTE AND UNIVERSITY [7, 8]
(England and Wales, 1952–3)

Line		Aged 15	Aged 16	Aged 17	Aged 18-20	Line
1	Total Number in age group	571,000	564,000	558,000	1,638,000	1
2	Number in Full-time Education					2
3	School	163,918	84,625	40,796	13,218	3
4	Technical College (Note A)	8,483	8,543	5,153	8,974	4
5	Art College/School	1,420	1,699	1,828	3,761	5
6	University (Estimated)	—	—	—	35,000	6
7	Total in Full-time Education	173,821	94,867	47,777	70,953	7
8	Per cent. of Age Group in Full-time Education	30·43%	16·44%	8·56%	4·33%	8
9	Per cent. of Age Group Full-time in U.S.A. [9]	88%	76%	61%	21%	9
10	Number NOT in Full-time Education	408,082	469,133	510,223	1,567,047	10
11	Number in Part-time Day Release	57,229	72,634	62,589	69,483	11
12	Per cent. of age group with Day Release	10·01%	12·87%	11·23%	4·24%	12
13	Per cent. Day Release of those not in Full-time Education	14·02%	15·48%	12·27%	4·43%	13
14	Number in Evening Classes					14
15	Technical	44,267	76,998	72,368	126,456	15
16	Art	6,041	7,838	7,817	15,533	16
17	Total	50,308	84,836	80,185	141,989	17
18	Line 17 figures as per cent. of age group	8·81%	15·04%	14·37%	8·67%	18
19	Number in Evening Institutes	119,736	88,526	63,141	73,884	19
20	Per cent. of age group attending Evening Institutes	20·96%	15·68%	11·31%	4·51%	20
21	Gross Total All Evening Classes	170,044	173,362	143,326	215,873	21
22	Per cent. of age group attending Evening Classes	29·77%	30·72%	25·68%	13·18%	22
23	Total per cent. of age group in attendance at all courses	70·24%	60·43%	45·46%	21·75%	23
24	Remaining per cent. of age group NOT in attendance (approx.)	30%	40%	55%	78%	24

Note (A) Totals do not include students in the National Colleges (Appendix, p. 603).

(B) The group aged 18 to 20 is of course affected by call-up to service in H.M. Forces, but many of them at present likely to be interested in or concerned with daytime courses secure deferment.

(C) No reliable figures of part-time education are available for the U.S.A.

social circumstances and differing rates of personal development have not received the kind of education suitable to their needs, and that which their parents wished to afford them. While the fascinating controversy over selection for secondary education has many causes and still more theories, into which we cannot enter here, perhaps the most urgent problem has been the distrust and apprehension of a single definitive examination, which seemed forever to exclude the possibility of a continued good education and a subsequent career in a profession or other desirable walk of life. These courses have in fact provided for such students a kind of safety valve in the educational system, enabling them to make progress when otherwise they would have been frustrated.

The question now is whether these courses will continue to function in this way. All the present signs are of a rapid growth, and not least because of the stimulus of the new General Certificate of Education which may be taken in single subjects and thus allow of a kind of piecemeal 'accreditation' of courses rather on American lines. A second factor is the general acceptance by the Universities of Advanced Level subjects for their entrance requirements, with a resulting decline in numbers entering for Intermediate degree examinations. This increase may, however, prove only to be temporary for the numbers are likely to diminish with better selection at 11+, with more pupils being encouraged to stay on at the grammar schools to 16 and beyond and, in the long run, perhaps the most important of all, the growth of senior and even sixth forms in modern schools taking the examinations, for example, of the Associated Examining Board (pp. 99, 149). Yet another significant development is that of co-operative arrangements between grammar schools and modern schools designed to gather up academic ability at 13+ or 15+ to be taken care of on special courses in the grammar schools. In the long transitional period before adequate and appropriate secondary education is provided for all, these courses are likely to flourish as more and more parents come to find in them the second chance they so often desire.

There are many vocational courses of one or two years' duration which are designed to ease the transition from school to work through the student gaining essential fundamental skills, and being made aware of the scope of various occupations and the conditions of the industries of which they are part. By their purpose and limited duration these courses may be described as technician in character and not technological, having an emphasis on skills with a sufficiency of related science and general education. Examples include courses in cookery and housecraft, catering, secretarial work, design and illustration, photography, printing, silversmiths' work, and many other crafts and skills. Closely related are various Ordinary National and College Diploma courses, for example in building and engineering, but these generally have not been successful. They could not recruit directly from the modern schools, and were not attractive to grammar schools in being below university standard; they raised problems of entry to industry especially in relation to apprenticeship schemes and they deferred industrial experience too long. Where they have succeeded it has been because they transcended or transmuted their original limited purposes and became recognised as a route beyond the technician level to management.

Generally speaking the age of entry to senior full-time courses has been 16 years of age, but this has been varied either by making exceptions or by running various *ad hoc* courses to fill the gap between the school leaving age and 16. For two-year Ordinary Diploma courses the normal standard of entry was a School Certificate with appropriate subjects such as mathematics and science, or satisfactory completion of a secondary school course to the age of 16 years or, to cover the rare cases of transference from industry, a year in employment and satisfactory completion of a part-time course, preferably the first year Ordinary National Certificate. Latterly the tendency has been to require the appropriate subjects at G.C.E. Ordinary Level, which is credit standard in the old School Certificate and therefore a raising of the standard of entry is being secured.

Higher Diploma Courses are of three or four years' duration with entry standards which can only be described as various and sometimes contradictory. These Higher Diploma Schemes have suffered from too much variation in purpose and standards, which are a consequence of a confused and changing industrial and educational situation. They have hitherto not fully justified themselves as a second route to advanced technology and to management alternative to degree courses, nor have they received the very active support of the professional institutions, even though these have been concerned in their administration (Chapter V), and have in some cases granted exemptions from parts of their professional examinations upon successful completion of the course. Generally speaking, the aim should be to make them three- or four-year courses with a final standard of attainment at degree level. For a three-year course this fixes the standard of entry at G.C.E. Advanced Level, usually in three subjects or, for the students now coming more plentifully from industry, successful completion of the related Ordinary National Certificate Course. For a four-year course successful completion of the second year of an Ordinary National Certificate Course is an appropriate standard of entry. In some instances there has been no appropriate external administration such as a Joint Committee to sponsor a Higher National Diploma Course (Chapter V). In such cases the college has usually awarded its own Higher Diploma or, as with certain major colleges, the Associateship of the College, as is awarded by the Royal Technical College, Glasgow; The Heriot-Watt College, Edinburgh; The Royal Technical College, Salford; and the Birmingham College of Technology. The significance of such awards is discussed in Chapter XV, but here it must be emphasised that the number of colleges granting Associateships must necessarily be severely restricted, otherwise Gresham's Law is bound to operate. Associateships are also obtainable for Art courses in some colleges, but the normal route of progression is through a two-year full-time course for the Ministry of Education Intermediate Examination in Art, and then for a further period of at least two years' study for the National Diploma in Design in some such specialised branch as ceramics, textile design, illustration, painting, sculpture or furniture.

Another significant group of courses are those for the degrees of London University (p. 160). Seven technical institutions differ from the remainder in having recognised teachers of the University of London and their students take Internal Degrees (Appendix, p. 610). The Charter of London University does not permit the extension of internal recognition beyond the London area and the students of other colleges therefore take the External degree, a system of university recognition which certainly troubles the enquiring foreigner (Chapter V). The full-time courses are substantially the same in content and standards, whether the students are registered as internal or external candidates.

In a comparatively few colleges there is a further major group of full-time courses of five or four years' duration and these are for highly prized professional qualifications; for example, the courses for the Associateship of the Royal Institute of British Architects (A.R.I.B.A.) (p. 320), and for the Associateship of the Royal Institute of Chemistry respectively (Chapter XIV; Appendix, pp. 610 *et seq.*). Closely related to such degree and professional courses is the provision of research and post-graduate courses, which are of rapidly growing importance in major colleges (Chapter XV).

'*Sandwich*' *Courses*

They are so called because 'layers' of full-time college study and industrial experience alternate over a period of years, for example, six months in industry succeeding six months in college and so on turnabout for three or four years. The American name is 'Co-operative' courses, because they can be run only by the closest co-operation between college and industry. There is a general belief that these courses are an American innovation or invention made in 1906 at the University of Cincinatti. Sandwich courses were in fact started in some form at the Royal Technical College, Glasgow, about 1880, and in the Sunderland Technical College in 1903, and in the Northampton Polytechnic, E.C.1, in 1905.

Whatever may be the historical precedence of the matter, there has undoubtedly been in the United States a more purposeful development of this kind of course and with it a more definitive literature. Thus a Committee of the American Society for Engineering Education [10] has set out the purposes of co-operative education as follows:

1. To impart first-hand an actual knowledge of, and experience with the execution in industry of engineering designs, projects and developments.
2. To impart understanding of, and familiarity with the problems and viewpoints of working men and women.
3. To assist students, by direct and personal experience in industry, to test their aptitude for engineering courses.
4. To enable engineering students to adjust themselves to engineering employments by gradual and easy transition from academic pursuits and mode of life to the requirements of industry.
5. To prepare students for the administrative and operating functions which, to a greater or lesser degree, enter into most engineering careers.

Just as laboratory periods in the training of the pure scientist, and the clinical experience of the medical students in 'walking the wards', so the experience in industry fulfils an essential need for the engineer *within the overall period of training*, and not in some post-dated period. The vacation works experience now increasingly arranged for university students is a belated token of this need.

In the American literature will also be found many further advantages listed, of which the following are most relevant to British conditions:

i. The student works in some of the most modernly equipped manufacturing plants and laboratories in industry. These are on a scale and standard utterly beyond the resources of any teaching institution, which is also spared acute problems of obsolescence.
ii. During the several works' periods the firm has a first-hand opportunity of observing the student's abilities and capacity for development, a form of selection by training which is probably more profitable than the usual summary or even extended interviews plus the college record on paper.
iii. The student must learn to work with all kinds of people and to follow instructions under industrial conditions, and he becomes acquainted with job practices, skills, labour and plant operation before rather than after graduation.

With all the foregoing points in favour of sandwich and co-operative courses it is a surprising fact, as noted by the *Universities and Industry Productivity Report* [11] that 'the system has not developed to any large extent. The scheme involves administrative difficulties on both sides which, whilst not insuperable may do much to offset whatever benefits the scheme may provide'. The Report is too summary in this matter, giving a guarded if not unfavourable assessment which is all of a piece with its classification of co-operative courses with evening courses, whereas they are far more comparable with full-time courses in status and hours of study. As there has been an expansion of sandwich courses since the war it is desirable to examine the causes of their limited development so far, and almost entirely in engineering only, so that suitable safeguards may be employed against potential dangers and inherent difficulties.

Sandwich courses cannot be successfully established unless both partners, college and industry, believe in them fully. Such a truism may seem superfluous but experience shows the cumulative drag of the half-converted on any innovation. The college staff may look longingly at the admittedly much simpler arrangements of full-time courses and dress this up in the academic argument that the student is not fully a student, and may thus quote, quite irrelevantly, many of the arguments produced against vacation work for academic students [12]. On the other hand, supervisory staff in industry may say that neither is the student fully a worker, his status and function are necessarily limited, and therefore that the admittedly troublesome arrangements are not justified by the results (which however can properly be assessed only when the scheme has been wholeheartedly supported or carried through for some years).

Another practical argument of consequence is that it is very difficult, if not impossible, to relate the college studies with the work of students in a large number of firms and an even greater diversity of occupations and jobs within those firms. The counter argument is that this betrays a confusion of thought about college studies, for these are not to deal with the specific industrial practices of the individual firms, but with the principles underlying them. The more the student sees these underlying principles being applied in practice, the better it is for both his theory and practice. Another academic argument is that the operation of economic and other non-scientific factors may prevent the student gaining a fully scientific insight into the problems involved. Again the argument is misconceived, for the mode of training is not for scientists but technologists for whom an understanding of the operation of these non-scientific factors is of vital importance, and that nowhere can the student under expert guidance gain as real an understanding of them as in industry itself.

Assuming, however, both industry and college to be fully persuaded of the value of sandwich courses, some inherent difficulties nevertheless remain. The variety of arrangements at present in force is mostly due to attempts to minimise these difficulties and the solution chosen depends mainly on the nature and structure of the industry, its distribution, and the consequent catchment area for the course at the college. If the catchment area is local, say 5–10 miles radius, a short periods basis, e.g. a weekly turnabout, may be favoured; a long-term basis, e.g. six-monthly periods, undoubtedly favours a much wider catchment area and may well require registered lodgings. Better still it may justify the setting up of hostels, thus giving these students the benefits of residential education alongside degree and other full-time students. A short-term basis makes it possible to interchange students, Cox-and-Box fashion, between industry and college so that the problems of industry are minimised while the college teaching staff are fully employed in teaching them throughout the three academic terms (the students spending the vacation, apart from their works holidays, in industry). On the other hand the six-monthly turnabout system does allow of greatly increased opportunities for research (hitherto lacking) and visits to industry by teaching staff in the summer term, and these opportunities have an enriching and vivifying effect on the teaching which all the year round teaching cannot give. One system found in the U.S.A., that of complete teaching throughout the year, with interchangeable groups of students, so that the teaching staff are really on an industrial basis with short period vacations (on a staggered basis), should be avoided at all costs. It is an unequal partnership in which the maximum convenience of industry is bought at a high cost in academic terms—in overloading teaching duties and in inadequate opportunities for further study and research.

One question is the minimum length of a period in college or industry to secure the maximum benefit to all parties: should there be a prolonged immersion or a series of repeated dips? The former gives a total effect with the advantage of full-time education, while the latter is a constant challenge to adaptability and provides a greater likelihood of integrating theory and practice. On the other hand, the prolonged period means a long gap in study, which some schemes attempt to offset by part-time tutorial classes during the works period. In the lists 1 to 5 and (i) to (iii) on pages 86–7, the advantages are usually to the student, and also to the college, but the advantages to industry are nevertheless very real. They are certainly positive enough to prevent any wise industrialist wishing to drive too hard a bargain, a deal of diminishing returns with overdriven students and staff. There is nothing absolute or sacrosanct or even as yet traditional about the relative length of periods in college and industry—all that matters about 'the thickness of the sandwich' is that it should be freely decided by discussion between the representatives of industry and the college and the scheme undertaken as a fully 'co-operative' enterprise.

The structure of the industry may have a critical effect on the administration of the course in deciding whether it shall be a 'college-based' or a 'works-based' course. In the former the students are enrolled by the college and placed in industry for the works periods, in the latter the students first of all enter industry and are then seconded or released by their employers to attend college. In America the schemes are preponderantly 'college-based' and this is due to several factors. With an administration centralised in the college, schemes can be worked with firms over very long distances (far greater than in Britain) and, for the college period, can more readily provide the necessary residential facilities. College-based courses on a Cox-and-Box arrangement for 'a student place' in the firm are more readily made from the college and this lines up well with the mass production basis of much of American industry. To these, the American colleges themselves add further arguments. The first is that the student remains primarily a student in training and not a full-time operative or employee subject to the full force of industrial hazards and problems. While the whole purpose of a co-operative course is to give real industrial experience, a student in training should not receive its full force and he should be 'eased into' the industrial situation. This is more readily secured, it is said, in a college-based course but there are cases where the College is only guaranteed a place in the firm with no choice or preference of the kind of work to be undertaken. Even so, it is argued that he must be adaptable, fit in and prove himself and make the firm wish to place him in a better position. The greater the established reputation of the institution the more it is able to insist on its students remaining *in statu pupillari* and having an integrated rather than an *ad hoc* works experience. This is shown, for example, in the co-operative courses at the Massachusetts Institute of Technology and especially in its works schools [10*b*].

In Britain the more general 'works-based' pattern may be due to the more closely-knit industrial conurbation, shorter travelling distances, but it is undoubtedly well founded in the established system of part-time day education which has not a counterpart on a comparable scale in the U.S.A. This has provided the basis of co-operation and it is significant that the increase of sandwich courses has waited upon the prior development of part-time day courses, just as these before had waited upon the development of evening courses. In both cases the changes have been accelerated by the impact of rapidly increasing knowledge and discoveries, which could no longer be adequately encompassed in the restricted teaching time available. Another influential factor has been the support of the professional institutions, both in the administration of schemes and in the granting of exemptions from professional examinations.

The Appendix (pp. 623–5) gives the present list of colleges with sandwich courses in England, Wales and Scotland: in 1953 there were about 1,050 students attending such courses in England and Wales, of which about 900 are in engineering courses. About 450 students entered all courses in September, 1953, of which 396 were in engineering. At the Royal Technical College, Glasgow, the respective figures were 550 and 175.

Sandwich course arrangements are applied to courses finishing at different academic levels, such as Ordinary National Diploma, Higher National Certificate, Higher National Diploma, and College Associateship (Appendix, pp. 623–5). The term Diploma is reserved for a full-time course or its equivalent, and a Higher National Certificate course is normally a part-time course (Chapter V). Academically the most important group is the Higher Diploma courses, and it may be confidently asserted that six months in college supported by six months' experience in industry is not less significant educationally than the university academic year, even when the latter is supported by vacational experience [13]. With comparable entry standards a three-year sandwich course thus reaches a standard equivalent to a university first degree.

The pattern of recruitment and entry standards to Higher National Diploma works-based sandwich courses is still not clear, and the lack of uniformity and clarity is retarding their general acceptance. Thus there are three-year courses recruiting students who have gained an Ordinary National Certificate (i.e. completed the S.3 stage) but there are a few with recruitment at S.2 for three years. These do not gain full exemptions from professional examinations (Chapter V), do not compare with university degrees and do not qualify for increased grants under Circular 255—Advanced Technology (Chapter XV). On all these counts they should not be called Higher (National) Diploma Courses. They should either be designated as Higher National Certificate (Sandwich Courses) or be upgraded to conform to the normal pattern. Some courses recruit for a four-year course students who have satisfactorily completed S.2 and are therefore equivalent to those of three years from O.N.C.

There is some controversy about starting a Higher Diploma course with an S.2 or with an O.N.C. (S.3) standard. With an S.2 intake a fuller scientific basis can be given as compared with the S.3 part-time course which the student would otherwise be taking. Practical considerations of recruitment however weigh heavily in favour of a completed O.N.C. (S.3) intake. It is asking too much of a college contributory to a major institution (where an H.N.D. course properly belongs) to forego the natural satisfaction of its labours in national awards. In these circumstances recruitment is not likely to be fostered. Again, if a student should fail or for some reason not complete the course (quite possibly not his fault), unless he enters with an O.N.C. he has no qualification to fall back upon. Prestige and human interests apart, however, there are other considerations. The Ordinary National Certificate is an award determined nationally and is external to the college, and thus affords a standard for work done in a wide variety of institutions. It is therefore an accredited standard of entry to a course, and as such, it is far more acceptable to Local Education Authorities for awarding Scholarships and grants, than is the unassessed S.2 intake.

The three-year part-time course is an integrated one in a way the first two years cannot be, and in that sense it forms a rather more defined preparation for a major course. Moreover an O.N.C. intake accords better with the recruitment of grammar school and secondary technical school pupils. Assuming these gain the Ordinary General Certificate of Education in appropriate subjects they may enter the second year of the O.N.C. and would thus have two years in industry, a period extended enough for the employers to assess their worth and for their continued academic promise to become evident. If the course is primarily or mainly college-based the related standard of entry is the Advanced G.C.E. in appropriate subjects. It must be emphasised strongly that the criteria for entry to a course are not educational ones only, but include personal characteristics which are more difficult to determine. Wherever possible selection should be made jointly by the firm and the college, based on the assessed ability to profit from the college study and the proposed works training.

There is also some controversy about the inclusion of management subjects in such courses. Some consider them premature and a waste of time, but this would have more force for full-time students as they have no relevant industrial experience in contrast to those in Sandwich courses. Management courses are discussed later (pp. 209, 371), but their aim should be to create in the student an awareness of industrial problems, and to fill out the general background of his particular technology and industry (p. 372). Such subjects as Industrial Economics, Methods Engineering and Employment Relationships are appropriate especially in the later years.

The success of sandwich courses, especially works-based ones, partly depends on the size and nature of the firms likely to be concerned. Many big firms pay wages during the college period, but there would be many more recruits from medium and the small firms if the problem of appropriate grants to students were solved satisfactorily (p. 525). The value of the 'Scholarship' given by the firm in continuing to pay wages to the student for college periods is not widely appreciated; it compares favourably with a State scholarship and is not subject to a parental income test. Generally speaking small firms do not and maybe cannot support sandwich courses, for they have not the resources in manpower to second students for the college period, nor can they readily commit themselves to taking on two students on an interchange basis. The nature of the industry affects recruitment and, as with part-time day release courses, the greatest support comes from the engineering industry. Since the war particularly, experiments have been and are still being made with Higher Diploma Sandwich Courses for other technologies and occupations, e.g. metallurgy, civil engineering, gas engineering, applied physics, building, bakery, and textiles. The building and textile industries in contrast to engineering, are those in which extended training has so far not been keenly felt to be essential to economic survival. We may hazard the conjecture that only those industries whose economic problems become painfully acute will readily co-operate in establishing new schemes of training in this as in other ways. This is likely to be still more true at the post-graduate stage where, by contrast with the U.S.A., we have not started on sandwich courses at all.

In an age of vastly growing science or technology the limitations of part-time day courses for *advanced* studies become ever more apparent. The choice is one of an increasingly circumscribed syllabus to attain the necessary level on a narrower front, which becomes self-defeating as the high level cannot be attained except on a broad basis of science; or of a strict limitation of height to the technician's level and scope, with no attainment of advanced technology. The solution is the sandwich course, a fertile hybrid as it were of the full-time and part-time course. Moreover the sandwich courses afford more liberal conditions for the development of a student's personality and interests, which are of great moment in qualifying for leadership in one or more of the various industrial fields, especially in manufacture and production, administration, and sales. The position in regard to these has also changed markedly since the National Certificate courses were started in 1921 because of the development by firms of university graduate apprenticeship or training schemes, which have produced excellent results especially in design and research. They have not been so successful in manufacture, production and administration, for which close contact with industry is probably desirable at an earlier age than 22 to 25 (later perhaps with extended research and with National Service. Such considerations make the sandwich course a desirable alternative complementary means of training and advancement within industry.

In sum, then, senior full-time courses range from one year's duration to as long a period as five years, from basic general and vocational education courses to advanced courses in science, technology and professional subjects and techniques, and beyond in standard to research, post-graduate courses, refresher courses and professional conferences. There are other courses which officially rank as part-time courses because they do not require more than 21 weeks of continued attendance in college, but the fact remains that the attendance, once begun, is full-time. In this category come the important group of courses catering for the needs of the Merchant Navy, such as navigation, marine engineering and wireless telegraphy. With these, especially marine engineering, there has recently been a strong movement to increase the length of the period in college to that of a normal full-time course, alternating with longer defined periods at sea (p. 412).

Secondary Technical Schools

The only other part of full-time work in technical institutions remaining to be discussed is that of the secondary technical schools, which mostly comprise the former junior technical schools together with some Technical High Schools established as a result of the Spens Report [14] and especially since the 1944 Act. Formerly the emphasis was junior *technical* school, now it is *secondary* technical school—they come within secondary and not further education, and are therefore not strictly within the scope of this book. Those who are particularly interested in their work are referred to pages 39–54 of Dr. W. A. Richardson's book *The Technical College* and to the Spens Report for their pre-war picture, and to the series of articles, etc., concerning their work and purpose given under reference 15. This is not to treat them as of little importance; on the contrary it is not to presume to undertake the separate specialised task of discussing their work but, more relevant to this book, to stress their significance and be free to consider their impact on technical education.

Though a completely accurate figure cannot be determined the relative numbers of pupils receiving secondary grammar, technical and modern education is broadly as in Table 9 [16].

TABLE 8

RELATIVE PROPORTION OF PUPILS IN
DIFFERENT SECONDARY SCHOOLS AND COURSES
(England and Wales, [illegible])

Ages 11–18	*No. of Pupils*	*Ratio*
Secondary Technical Schools and Courses*	[illegible]	1
Secondary Grammar Schools and Courses (including Direct Grant)	[illegible]	[illegible]
Secondary Modern Schools and Courses	[illegible]	[illegible]

The ratio provokes grave doubts as to whether this is a proportion appropriate to the needs of a commercial and industrial nation. Technical education would be much better based were the proportion of secondary technical education larger, for pupils of these schools have already made a remarkable contribution to senior college work (p. [illegible]).

All being well the pupil should, as a result of his secondary technical education, leave school imbued with a desire for work, an awareness of the need to maintain standards, with an objective view on life and with a pride in his vocation. He should then be animated and sustained throughout his future career, whether in industry with attendance at part-time classes or through senior full-time and sandwich courses.

Those who work in the senior colleges know from experience that the old 'junior techs.' have achieved no less than this with innumerable boys, and wonder how long it will be before a much larger number of secondary technical schools and courses will be created to make this possible for a much greater number. At present, schools are providing secondary technical courses in engineering, building, textiles, housewifery, catering, commerce, art (though the position of junior art departments remains anomalous), agriculture, but their relative number bears no direct relation to the number employed in the industries and occupations into which their pupils enter (Table 8a). The expansion required is not simply an overall one but a question of encouraging some more than others, and even introducing new courses. Considering their potential importance to the community the lack of attention to these and related problems is quite surprising.

One problem which must be discussed is the relationship between secondary technical schools and technical colleges [[illegible]]. After the passing of the 1944 Act there was a sharp conflict of views which derived in part from the new-found status (real or anticipated) of the junior technical schools and from the uncertain future of technical education itself. There were those who conceded no virtues in the presence of the schools within the colleges, while others admitted no defects in so close a relationship. There were those who, mindful of the struggle to establish the schools in the past, felt impelled to resist any attempt at separation, while others, impressed with the urgent possibilities of development in senior work, were anxious to be rid of an embarrassment at the earliest possible moment. With the continued development of senior work some aspects of this controversy have become clearer, but the conflict of views remains and leads to bitter letters in the educational press from time to time. About two-thirds of the schools with over half the pupils are still housed on the premises of further education establishments as shown in Table 9A.

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*If the figures for Schools only are used, the ratio is 1 pupil Technical to [illegible] Grammar to [illegible] for Modern.

If the figures for ages 11 to 14 only are used the ratio becomes 1 pupil Secondary Technical to [illegible] Grammar to [illegible] Modern.

TABLE 9A

SECONDARY TECHNICAL SCHOOLS 1952–3
(England and Wales)

(i) *Schools and Enrolments*

	No. of Schools	*No. of Pupils*
Schools housed in Further Education Establishments	167	43,660
Other Secondary Technical Schools	83	35,554
	250	79,214

(ii) *Types of Courses*

	Number of Pupils in	
Course	*Schools in Further Education Establishments*	*Other Schools*
Art	773	2,190
Agriculture	184	38
Building	6,609	1,982
Commercial	6,212	5,821
Dressmaking	443	413
Engineering	14,548	4,984
Housecraft/Household Management	235	83
Handicraft	146	25
Pre-Nursing	330	—
Others	1,530	476
TOTAL	31,013	16,012
Separate Totals not Available	12,647	19,542
	43,660	35,554

It therefore still seems desirable to set down the main points of controversy in the hope of clarifying the issues.

There are advantages and disadvantages claimed for both school and college. For the school there are said to be five main advantages:

i. *Senior Expert Staff,* with indispensable industrial, commercial or artistic experience, are available to ensure the reality and efficiency of the vocational classes.
ii. *Specialised Equipment* is available, which cannot be provided in many places, so that a joint arrangement ensures economical use.
iii. *Planned Courses* secure continuity of progress into senior courses.
iv. *Employment* is more readily secured because of the industrial and commercial contacts of the college.
v. *Prestige* is gained by the school when it is part of a large well-equipped college.

For the college the advantages have been fewer but they have not been unimportant:

i. *A supply of students* is facilitated and, moreover, those with the right outlook and training. This is seen at once in the remarkable proportion of Higher National Certificates gained by ex-junior technical scholars (p. 224).
ii. *Greater availability of full-time staff* has been possible, both technical and on the general educational side. This has been of the greatest value in assisting the development of part-time day and evening classes in the smaller institutions, but it is likely to be a factor of diminishing importance with the rapid development of senior technical work.

These advantages have been mutual; so also have been the disadvantages of which the following are the most important:

i. *A conflict of discipline* results with school pupils alongside senior part-time day students, many of similar age and with different groups each day, and senior full-time students, perhaps including those in university degrees and higher diploma courses.
ii. *Complexity of timetables for staffing* and accommodation, with rigid arrangements, imposing an undue need for consultation between Principal and Headmaster. With overcrowded conditions this requires the greatest goodwill and mutual consideration to ensure harmonious working—a situation greatly at the mercy of personalities, congenial or otherwise.
iii. *A conflict of interests* is always likely to arise, especially in the use of specialised rooms, and in the provision of out-of-school activities.
iv. *A conflict of future interests* is almost certain to arise: indeed, since the war the problems of expansion have become acute.

Many Principals have been embarrassed by a choice of priorities of development or, what is worse, by not being able to develop the senior work at all until the school is housed in separate premises.

v. *Prestige.* A school is one thing, a college another and it is no disparagement of schooling to insist on this differentiation, nor to say that it is difficult to raise the prestige of a college with a large number of school children within it. If it is done it is despite this. At the same time it is said that the lack of independence of the school detracts from its standing compared with that of the grammar schools. The value put on these contentions is apt to depend largely on the relative size of school and college, the possibilities (real or imaginary) of development, and, what is seldom mentioned but weighs heavily with parents and employers, the general standard of staffing and amenities.

With these many points in mind, what has been the effect of the 1944 Education Act on this juxtaposition of school and college, and what further changes are likely? For the school there are two main considerations:

i. *The need to lower the age of entry to 11 years.* In the past the Junior Technical Schools which recruited at 13 years, had not parity of selection with the grammar schools; now they must recruit from the secondary modern schools whose heads are naturally interested to keep their best pupils to build up their schools, and have every inducement to do so. Any hope of adequate selection for secondary schools at 13 years, or of transfer between them, is too slender as a basis for practical considerations. Things being as they are, or are likely to be in the near future, the pressure is all directed to securing entry to the secondary technical school at 11 years of age—whatever the psychological evidence may be.

ii. *Increase in age range to include 16–18 years.* Again we have the argument of parity with grammar schools, though not with the same force as the 11+ argument at present. But there is here a likely conflict of interest with the technical colleges, with an increasing stress of argument concerning specialist staff and equipment.

For the technical college there are three main factors:

i. *Increased Volume of Work.* This has already taken place since the 1944 Act, creating the problems of choice of development already mentioned. Moreover it is permanent and will grow still further. In these circumstances the colleges need no longer think in terms of the 'scarcity-values' of former days, when the junior technical school was a 'godsend to fill up the place in the daytime'.

ii. *Increased Variety of Work and Students.* These also have come about since the war and will continue. They arise from students taking courses after military service and those with extended day-release (note the 36,918 aged 21 years and over), students in sandwich courses, refresher courses for executives, foremen and others, those undertaking research, post-advanced/post-graduate courses, etc., all of which make it undesirable from both points of view to have a school within a college.

iii. *Increased Numbers of Secondary Technical Schools.* 'The slow progress of Secondary Technical Education' [16] has been critically examined by A. J. Jenkinson, and lack of progress here is one of the major failures in working out the Education Act in the post-war decade. If this is to be remedied then the number of secondary technical schools must increase greatly, and in any such expansion the schools could not remain directly linked with the technical institutions any more strongly than the grammar schools are with the universities, quite apart from any question of bilateral schools—grammar and technical or modern and technical, or possibly high schools on lines advocated by Dr. W. P. Alexander [18].

It is well therefore to assume that with the expansion on both sides, senior and junior, separation is inevitable in the great majority of cases. Joint working is likely to remain only in small local colleges of further education with no substantial volume of senior full-time work but with county colleges or part-time day release courses. In sum, joint working should be undertaken or continued only where it is manifestly to the good of both sides. Where the foregoing advantages, which did not disappear when the 1944 Education Act was passed, clearly exceed the disadvantages, the latter can still be greatly minimised with good will and co-operation, but certain essential conditions should be secured—clear articles of governance, relative responsibilities of the Principal and Headmaster, especially as regards ultimate decisions regarding staffing and accommodation, so that there is no danger of a cuckoo in the nest or unreasonable treatment of a younger minority (Chapter XVI). The siting of the separate schools near the technical college could clearly be advantageous to both.

Just as the development of secondary grammar schools was stimulated by the examination for the School Certificate (whether they regretted its other effects or not), so perhaps the growth of secondary technical schools may be stimulated by the work of the Associated Examinations Board for the General Certificate of Education established in 1953. This will offer examinations having a bias towards the particular needs of pupils in technical, commercial and modern secondary schools and classes, for example, in the following, art, building subjects, domestic subjects, economics and commercial subjects, engineering subjects, geography, handicrafts, mathematics, modern languages, science. The City and Guilds of London Institute is responsible for the administrative work (p. 152). Another contemporary development should be noted in the arrangement between the Union of Lancashire and Cheshire Institutes and the Northern Universities Joint Matriculation Board (p. 149). It is difficult to assess the future of these innovations but they will be watched with great interest.

Changes bring difficulties and doubts, and many who have seen or contributed to the successful work of the junior technical schools in the past have fears and regrets about these changes, actual and impending. Some fear that they will decline—vocationally speaking—into grammar schools or modern schools, or by absorption into all-enveloping-multilateral schools or high schools guided by academic heads. Snobbery and misguided educational aims will do their worst unless there is care and vigilance. Recently a grammar school was celebrating the Jubilee of its foundation as a technical school in the days of 'whiskey money'. With fine unconscious irony the chief speaker proclaimed 'What changes, what developments, what transformations have we seen! How those who started this school would have marvelled at what we see to-day!' The recent series of articles on the secondary technical school in the *Journal of Education* and *Times Educational Supplement* [15], show continued concern about their work and future, which is not surprising with the foregoing history in mind, and the proposal to abolish them altogether [18]. This is in direct contradiction to the view expressed by Sir Godfrey Ince:

> I personally am delighted at the development of secondary technical schools—it seems to me to have great possibilities for both the youth of the country and for industry and the professions. Naturally at the beginning of a new development of this kind one expects to find caution, but I hope that caution will not be carried too far and that in the future we shall see a real element of boldness and imagination coming into the development of these secondary technical schools [19].

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CHAPTER IV

GENERAL WORKING ARRANGEMENTS AND COURSES (MAINLY PART-TIME)

Part-time Day Courses

BEFORE we consider these courses from the internal college viewpoint it is well first to review their development and the underlying factors which still determine their size and character, for a more striking example of the influence of economic and social factors on the work of an educational institution could hardly be found. Since pre-war days part-time day education has expanded some seven times as shown in the Table 2 (p. 6) and not unnaturally there has been a good deal of satisfaction at the progress made. There is indeed a risk of complacency, so that it is of first importance to look at the total scale of the problem if the provisions of the 1944 Education Act are to be met. The issues involved can best be seen by separate consideration of the various groups attending part-time day courses, namely, those engaged in employment aged 15 to 17 years of age, those 18 years of age and over also in employment; and secondly, the various other groups such as leisure classes and so forth. There are some who understandably dislike the term 'day-release' for those in employment, as implying a release from bondage or at least unavoidably unpleasant conditions; but we shall use it as it has passed into our educational terminology or jargon, and it is most unlikely to be displaced.

The varying composition year by year since the war is shown in Diagram 7. Unfortunately it is not possible to derive a similar diagram in terms of student hours of attendance. If it were, it would almost certainly show a far greater relative expansion of the 'volume' of work in day-release courses, for these are mainly on a full-day basis whereas most of the other part-time day classes are on a half-day basis.

The continued rise of day-release numbers is striking, but further analysis is required into different age groups to appreciate the significance of the expansion of day-release respectively at the county college age range and beyond it. Diagram 8 shows the age groups in 1952–53 and the figure of 106,401 students over county college age, including 36,918 aged 21 years and over, is very remarkable; these figures are 34·4% and 11·9% respectively of the total day-release of 309,255.

Diagram 8 also shows that many fewer women students are enrolled to attend these courses than men, but how far this is due to the kinds of occupation mostly held by women is difficult to determine (p. 332). The diagram does show a greater equality of treatment at the county college age range than later.

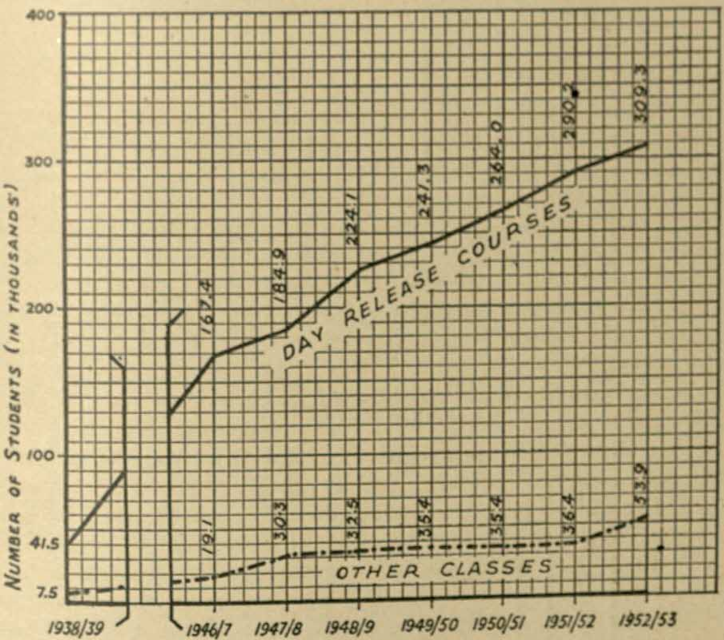

*DIAGRAM 7.**

GROWTH OF PART-TIME DAY COURSES AND CLASSES

(England and Wales, All Establishments)

Source: Ministry of Education Report, 'Education in 1953'. Tables 44 and 51, and equivalent Tables in previous Reports (H.M.S.O.)

The different rate of expansion for the different age groups is shown in Diagram 9, being most rapid for the county college group.

The increase shown in Diagram 9 for the 18 to 20 age group may be thought surprising in view of call-up for

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* Day release figures 1953–4 Session = 326,223: 1954–5 = 354,941 students.

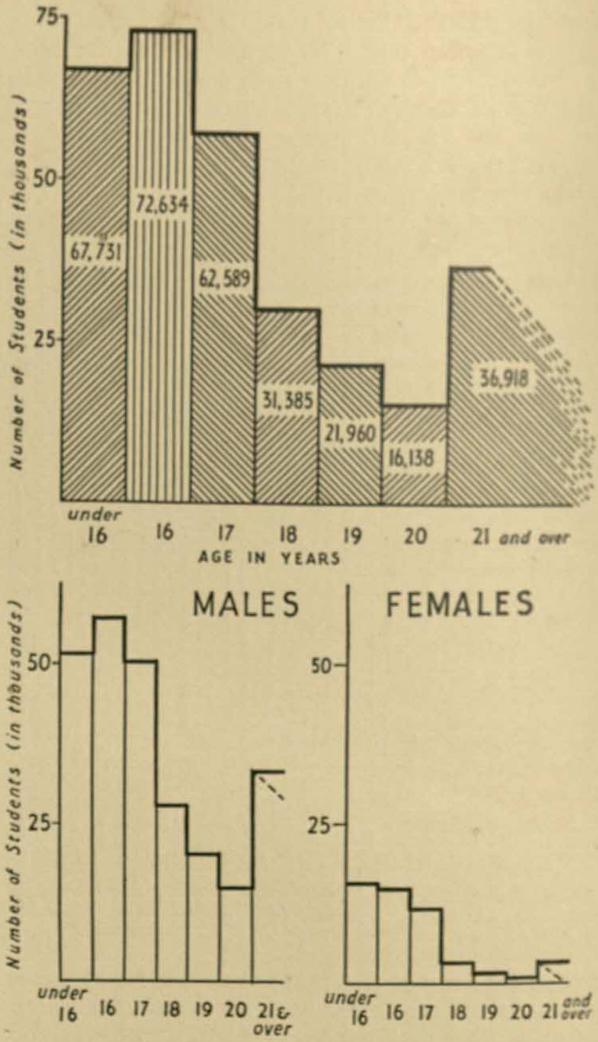


DIAGRAM 8. AGE GROUPS IN PART-TIME DAY-RELEASE COURSES
(England and Wales, 1952–3)

Source: Ministry of Education Report, 'Education in 1953', Table 51 (H.M.S.O.)

military service; on the contrary, it is due in part at least to deferment from military service for those in courses of training recognised for this purpose (p. 80).

The rate of expansion of the county college group shown in Diagram 9 may be misleading, and give rise to false optimism.

The full significance of Diagram 8 is seen only when the comparison is made of the foregoing age groups against the total number who could attend part-time day courses if all arrangements were satisfactorily made. Section 43 of the 1944 Education Act laid down the duties of Local Authorities:

> To establish and maintain county colleges, that is to say, centres approved by the Minister for providing for young persons who are not in full-time attendance at any school or other educational institution such further education, including physical, practical and vocational training, as will enable them to develop their various aptitudes and capacities and will prepare them for the responsibilities of citizenship [1].

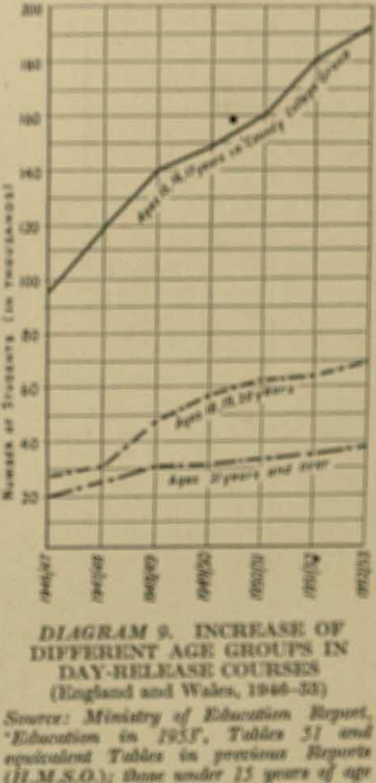


DIAGRAM 9. INCREASE OF DIFFERENT AGE GROUPS IN DAY-RELEASE COURSES
(England and Wales, 1946–53)

Source: Ministry of Education Report, 'Education in 1953', Tables 51 and equivalent Tables in previous Reports (H.M.S.O.); those under 15 years of age are not included.

The county college is to deal wiht young persons over school leaving age until they reach the age of 18, i.e. aged 15, 16, 17 years, and the figures are given in Table 8, lines 12 and 13 (p. 82). Of the county college group aged 15, 14·02% are in attendance; 15·48% of those aged 16, and 12·27% of those aged 17 years, *an average of* 14% over the whole county college group.

Though we must not disparage the vision and courage of the originators we must admit that at the beginning of any development it is not very difficult to record a sevenfold expansion and we must be chary of describing it as 'the present revolution' [2]. We may speculate as to when 'the revolution' will overturn the whole, especially when we recall that a public meeting was held on 4th December, 1953, to celebrate the starting of day continuation classes by Cadbury Brothers and the Birmingham Education Committee 40 years before [3]. This event led to a lengthy correspondence in *The Times* [4], full of hopes, wise counsel and the fruits of experience, but all this cannot alter the hard fact that for this age group in England and Wales we have another sevenfold expansion still to achieve. In Scotland the position appears much worse [5]. The quantitative measure of the task which lies ahead can most readily be seen from Diagram 10.

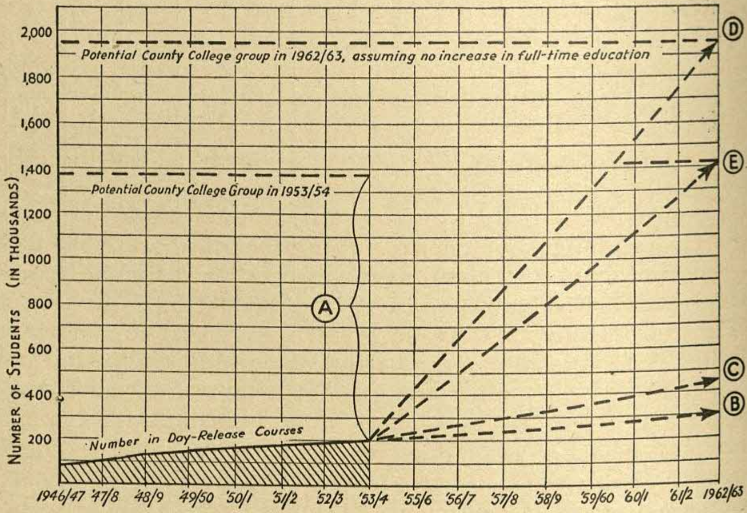


DIAGRAM 10.

ACTUAL AND POTENTIAL COUNTY COLLEGE STUDENTS
Ages 15, 16 and 17 years

Source: Ministry of Education Report, 'Education in 1953', Tables 2 and 51, and equivalent Tables in previous Reports (H.M.S.O.)

The gap in present provision for those *not* in full-time education is shown by (A) in Diagram 10. This is formidable enough but the 'bulge' passing through the schools will reach the 'county college' groups about 1961–63, and the present total 15–17 age group of 1,693,000 will have increased to about 2,380,000 between 1962–65. Assuming that much the same proportion of children continue in full-time education the potential expansion required is to point (D) in Diagram 10. If more stay at school the gap will be correspondingly reduced, and if by then the school leaving age is raised to 16 years the number remaining for the county colleges is represented by point (E) in Diagram 10. At the last two years' rate of expansion point (B) in Diagram 10 will be reached by 1962–63; taking the best average post-war expansion the result will still only be that represented by point (C).

Diagram 10 should drive home the scale of provision yet to be made in creating county colleges, but the problems are likely to be even more acute. At present most part-time day courses total about 220 hours per annum whereas Section 43 (8) (a) of the 1944 Education Act requires 'not less than three hundred and thirty hours instruction in a period of twelve months'. To comply with this, present day courses, on average, would need to be increased by one half, with formidable requirements in staffing and accommodation. These cardinal problems combined with one another to wreck all hopes placed on the Fisher Act, except in the unique case of Rugby which has been recounted by its Principal, Mr. P. I. Kitchen, O.B.E., in his book *From Learning to Earning* [6].

Moreover, there is the imperative necessity to bring the whole scheme into effect on the same appointed date everywhere. Assuming that the present number of about 1,387,000 is to be gathered into county colleges, and that the daily distribution is a reasonable average, there would be a maximum daily roll of about 370,000 students. Assuming normal staffing ratios (despite special requirements) and allowing for a 7¼-hour day as against the present usual 6-hour day, this means that about 22,500 teachers would be required. Against this may be set a present estimated total of 2,200 teachers engaged on this work so that about 20,300 additional teachers will be required, a formidable total indeed [7]. Of course the scheme would be brought in over a three-year period, requiring about 7,000 more teachers annually for three successive years. There is unlikely to be a great increase in works schools (p. 186), though these can probably be more readily staffed with teachers remaining in industrial employment than entirely separate county colleges. With no material changes in these respects there will be some 665,000 more young people age 15–17 years in employment (with important consequences for full employment) (Chapter VI) and this would mean a 50% increase in staffing on the foregoing figures, a requirement of 31,900 teachers altogether or 10,600 per annum for three years. Finally many of these teachers will need to have had industrial or other specialist experience. All in all, the problem is formidable but not impossible of solution.

One further question of great importance is whether the occupations of those already released are different in kind and scope from those not at present in attendance but who would attend county colleges. Table 10 is therefore of particular interest [8].

TABLE 10

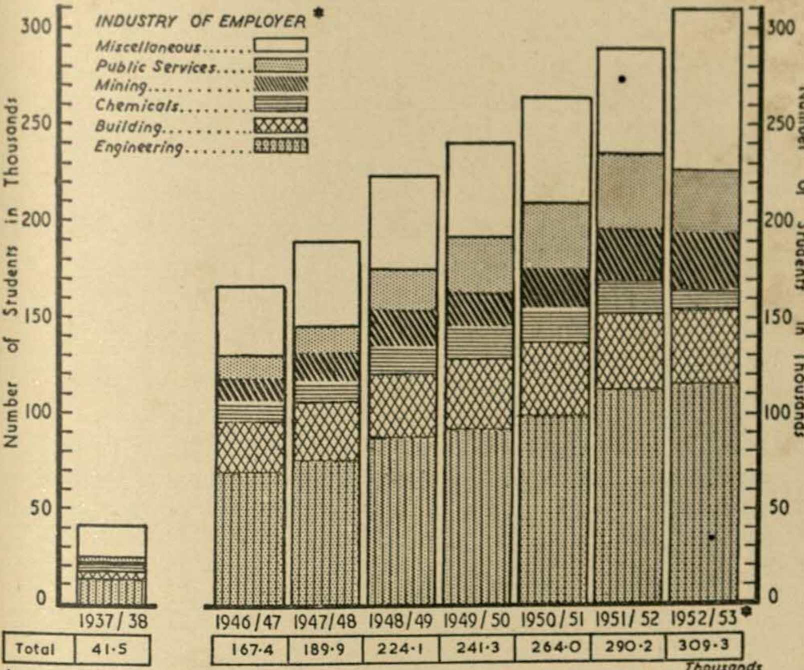
DAY-RELEASE STUDENTS
CLASSIFIED ACCORDING TO THE INDUSTRY OF THE EMPLOYER

Industry	Release to Technical Institutions	Release to Art Institutions only	Total Release for Industry	Percentage of Total Release All Industries
Agriculture and Horticulture	927	1	928	0·30
Mining and Quarrying	29,691	—	29,691	9·59
Treatment of Non-Metalliferous Mining Products other than Coal	1,113	193	1,306	0·44
Chemicals and Allied Trades	10,440	55	10,995	3·55
Metal Manufacture	3,618	67	3,685	1·19
Engineering, Shipbuilding and Electrical Goods	115,138	180	115,318	37·25
Vehicles	5,036	27	5,063	1·63
Metal Goods not elsewhere specified	594	—	594	0·19
Precision Instruments, Jewellery, etc.	361	337	698	0·22
Textiles	5,117	184	5,301	1·71
Leather, Leather Goods and	150	54	204	0·07
Fur Clothing	2,979	79	3,058	0·99
Food, Drink and Tobacco	6,805	72	6,877	2·22
Manufacture of Wood and Cork	1,083	575	1,658	0·53
Paper and Printing	6,794	3,683	10,477	3·38
Other Manufacturing Industries	2,611	3	2,614	0·84
Building and Contracting	34,230	4,695	39,195	12·66
Gas, Electricity and Water	5,533	6	5,539	1·79
Transport and Communication	10,966	196	11,162	3·60
Distributive Trades	10,353	162	10,515	3·39
Insurance, Banking and Finance	160	—	160	0·05
Public Administration and Defence	16,203	278	16,481	5·32
Professional Services	24,054	1,297	25,351	8·19
Miscellaneous Services	2,667	218	2,885	0·93
TOTAL	296,623	12,632	309,255	100%
% of Total	95·92	4·08	100%	

Out of fifteen different categories the first six biggest proportions (in decreasing order) come from engineering industries, building, public utilities and local government, chemical industries and commercial and professional occupations. These industries are ones in which training is vitally necessary to their proper performance or economic survival. Assuming for the moment that this is so, we may look at Diagram 11, which shows their relative development since the war [9].

There has not been a strong differential development but three groups have increased in much the same proportion.

The major groups, engineering, building, chemicals, mining and public services, comprise the greater part of day-release, and its general rate of increase over these years is the direct result of the increase of these main groups. In other words the extension or spread of day-release into other occupations and industries has been negligible in comparison with the expansion of day-release in industries where it has been long accepted. In terms of industries we are still preaching only to the converted.



*For 1952/53 the industries were classified in accordance with Standard Industrial Classification

DIAGRAM 11. ANALYSIS OF GROWTH OF PART-TIME DAY RELEASE BY INDUSTRIES

From Ministry of Education 1953 Report by permission of the Controller H.M.S.O.

The kinds of part-time day course available have been and still largely are professional in character and designed to lead to advancement in industry. Whatever may have been the original purpose of the National Certificate system in terms of the education of technicians, it has in fact become a much frequented route to the desirable professional standing, for example, of a qualified engineer. With limited resources and the desire for prestige, technical colleges have hitherto concentrated upon professional and degree courses to the comparative neglect of craft courses. Moreover—and this has been a serious criticism of the content of higher courses provided for industry—it has been possible to run these higher courses with fewer practical facilities than would be necessary for craft and practical technological courses. This is one of the reasons why, in Pamphlet No. 8, *Further Education*, para. 29, it is stated that 'the practical education of the lower grades of industrial workers has been attempted only to a small extent'. Another reason given is that the standard of education of the worker has been too low to form a sound basis even for a light structure of technical and scientific training. It is hoped that a year's extra schooling, especially when the long-delayed reduction in the size of classes is achieved, will do a great deal to remedy this, but, as already noted, it creates a serious teaching problem, especially when part-time day classes are too small to allow of proper grading. The changing attitude of industry may also ease the situation (p. 173).

The nature of part-time day courses is indicated by the industries listed in Table 10, and these are provided for three main levels leading to professional, technician and skilled craftsmen, or equivalent and, much more rarely, semi-skilled occupations [10]. This purpose largely determines the length of the course, the majority being of three, four or five years at the technician and skilled craftsman level, and up to seven or more years for professional qualifications. The general arrangements of these courses and the resulting qualifications are dealt with under various partnerships in technical education (Chapter V), and their technical details in Chapters VI to XIII.

Part-time day-release courses are very varied, but the main types are shown in Diagram 12. The minimum time for completing a B.Sc.(Eng.) London External Degree Course is shown in (i) and assumes that the student has no mishap on the way. It is a very exacting course and not the least difficult part is that for the Intermediate Degree, or Advanced G.C.E. at the end of two years. The difficulty arises directly from the previous education of the student. If he comes from secondary education with all or most of his G.C.E. Ordinary Level subjects he will enter Course (i) and if he has the Advanced G.C.E. requirements he will enter the Part I Final Course. If he has only partial Advanced G.C.E. requirements he will probably enter the second year and complete the requirements at the end of that year (the ages shown in the diagram are not rigid but give the minimum likely conditions). Course (ii) shows the normal sequel for a student with few Ordinary G.C.E. subjects which he may complete in stages, or take the minimum number and hope to complete the Advanced G.C.E. in three years. Problems of deferment should not be overlooked, especially because the student wishing to take an External Degree cannot secure deferment until he has Intermediate or the Advanced G.C.E. In that case the student's course is lengthened by two years' National Service. While it is possible for a student to enter such a course directly from an Evening Institute Preliminary Senior Technical (P.S.T.) Course, this is now very unusual and he is generally advised to take the National Certificate Course. There is still a significant number of students who complete the Higher

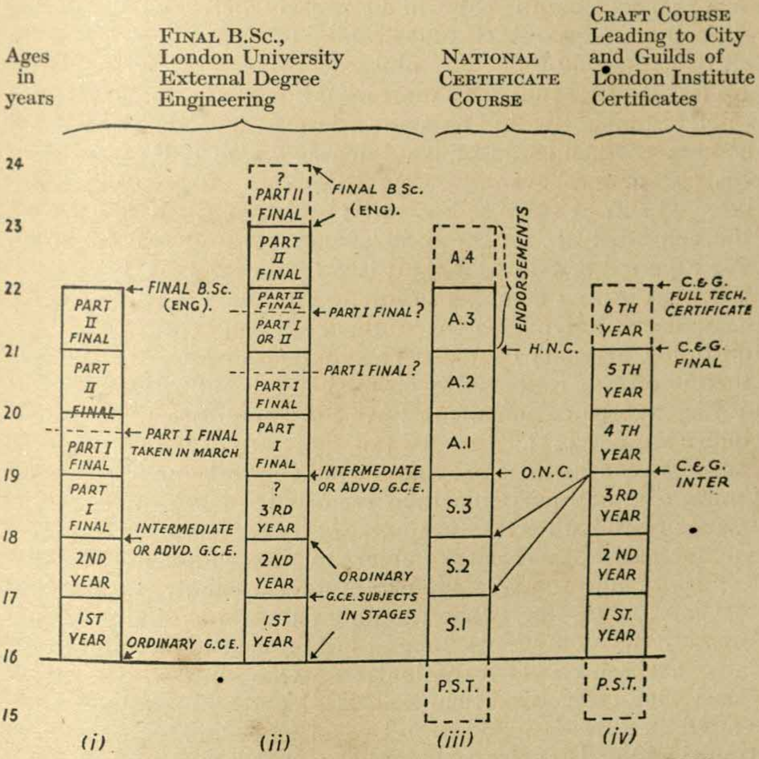


DIAGRAM 12. GENERAL ARRANGEMENTS OF PART-TIME DAY-RELEASE COURSES

National Certificate Course and then start on the degree course, even though the firm understandably no longer grant day-release. This reflects the higher social prestige of a university degree and/or the lack of a more broadly based Higher National Diploma Sandwich Course (pp. 86–94).

The difficulty of the course is also directly related to the time available in college. The rate of progress as between course (i) and course (ii) will be greatly determined by the proportion of day-release and evening attendance. Course (i) can be managed on one day plus one, or preferably two evenings (or one plus Saturday morning), but at the Final stage it is better managed—in the sense of more effective study and the greater likelihood of a good degree—with 1½ days' release plus one or two evenings. At Rugby the degree course is arranged in close co-operation with British Thomson Houston Co. Ltd., on the basis of one day and two evenings over a period of two years and two terms for Part I; and for Part II full-time attendance for four terms. 'The Course is particularly designed as the "industry-based" equivalent of a full-time University course. The young professional engineer, starting on this route to his professional qualifications, builds up his experience concurrently in his apprenticeship and his college studies' [11].

Similar considerations apply also to the National Certificate Course (iii), and particularly as regards the completion of the Higher National Certificate Course and endorsements (p. 157). The increased day-release of older students shown in Diagram 8 (p. 106), is thus a very important development. Course (iii) of Diagram 12, shows the minimum time, but many, if not the majority of students, take at least a year longer and some have several repeat examinations which poses important questions of selection (Chapter VII). Craft courses are more varied in duration and standards than other courses, but course (iv) of Diagram 12 shows the arrangement, again on a minimum time basis, for a five-year course for the City and Guilds of London Institute (p. 150) Final Examination in Machine-shop Engineering. In the building crafts the Final Examination is taken at the end of four years, and the endorsements or additional subjects for the Full Technological Certificate, where such is applicable, in the following or subsequent years as the student can manage to complete the necessary study in the time available to him; this is normally only in the evenings at a period when he is taking on increased responsibilities. Very able students may be encouraged to transfer to the National Certificate Course at a stage which is determined by the relation of the subjects studied on the two courses. No selection system will ever be perfect and social factors may supervene to disturb a young person's ordered progress (Chapters VII and XVII), and for an able student to be permanently subject to adverse conditions is unjust and frustrating. This movement or 'escalation' between courses, though small, is therefore very important in preserving lateral flexibility in a vertical structure, a feature much admired and indeed desired by Continental educators seeing our system at work. This is apt to be overlooked by over-tidy minds anxious to specify entry requirements to courses in terms of G.C.E. subjects only.

Another important matter, closely related to management requirements and especially its problems in industry and commerce, is that of continued general education. Indeed this has become of such importance as to be a subject of continuing controversy and to have resulted in the setting up of a special committee to consider it [12]. This controversy has thrived on the continued juxtaposition and confusion of ill-defined terms such as vocational and non-vocational, vocational and general studies, vocational and liberal studies, vocational and humane studies, leading not unnaturally to such an antithesis as 'a broad liberal education and a narrow vocational training'. With the changeover from evening classes to part-time day courses the hours of attendance have increased from about 150 to about 220 per annum, i.e. about a 50% increase, thus making substantial changes possible. But with the high technical standard aimed at, the extra time has been gladly, not to say avidly, seized upon to fill out the vocational subjects, increase their content, and bring in more of the basic science and mathematics to meet rising external compulsory standards. Though there are exceptions this is true of most day-release courses. But if the county colleges were brought into being, the hours would again be increased by about 50% from some 220 hours to 330 hours per annum. Again, for the more technical courses, there would be the same temptation to repeat the process.

It is well therefore to recall that the Act required the county college to provide 'such further education, including physical, practical and vocational training, as will enable them to develop their various aptitudes and capacities and will prepare them for the responsibilities of citizenship'. Once again they will pose the problem of the balance of studies, specific training and continued general education in an acute form. As things are at the moment, there seems little likelihood of a ready and wide acceptance—except in some day continuation and works schools—of a timetable made up as indicated in *Youth's Opportunity*. There the suggestion is a day 'of eight periods, of which one and a half are to be given to physical education, three to practical, two to general and one and a half to elective activities. Such a day seems to give the necessary balance of movement and stillness, of physical and mental activity, of free choice and imposed, and of active and passive participation' [13]. Against such a picture of perfection most schemes present a disturbing imbalance (Chapter XXVIII).

The 1944 Act allows of an alternative mode of attendance in continuous attendance 'for one continuous period of eight weeks or two continuous periods of four weeks in every such year'. This may be preferable where a young person is employed in an industry with widely varying seasonal demands, as, for example, in agriculture and in the catering trade in seaside resorts. There would probably be a different arrangement in rural areas contiguous to towns but in thinly populated areas the best solution is that of a residential college. The Ministry's pamphlet No. 3, *Youth's Opportunity*, discusses four ways in which a county authority may provide for its rural part-time students (i) by sending them to a day college on the outskirts of a small town, (ii) by establishing residential colleges, (iii) by combining the residential college with the day college by building a hostel at the latter, and (iv) it may attach a day college to some existing community centre or, less desirably, to a secondary school. A period of residential college life can have a profound social effect compared with the brief weekly visit to a day college, an effect which might well be as profound for this age as the Danish Folk High Schools have been with adults [14]. On the other hand, it seems probable that the educational effect through the knowledge and skills gained may well be greater with attendance and contact kept up throughout the year. In the absence of extended experiment, argument on these two aspects can undoubtedly flourish, for at the moment there is no evidence on which to decide. Indeed a comparison of Pamphlet No. 3 with the 1954 Report of the Working Party on Agricultural Education [15] is definitely discouraging with major problems yet to be solved. On reflection, we could hope that the best could be secured of both worlds and that both modes of education could be combined. This is in effect what is already happening with the increasing opportunities for residential education provided for young people in employment, in residential colleges, extra mural departments, the Outward Bound Schools and so forth (Chapter VI).

TABLE 11

SUBJECTS STUDIED IN EVENING CLASSES IN MAJOR ESTABLISHMENTS (OTHER THAN ART) AND EVENING INSTITUTES

(England and Wales 1951–2)

	Student Hours of Attendance	Approx % of Section
SECTION A: GENERAL SUBJECTS		
1. English	5,002,736	11·89
2. Languages Other than English	2,419,883	5·74
3. Social Sciences	1,494,162	3·55
4. Mental and Moral Sciences	123,759	0·31
5. Mathematics and Natural Sciences	12,806,897	0·43
6. Art	1,539,675	3·65
7. Handicrafts	7,155,347	16·99
8. Music, Elocution and Theatre	3,890,775	9·24
9. Physical Culture	7,241,458	17·20
10. First Aid and Hygiene	320,406	0·76
11. Grouped General Courses	99,214	0·24
Percentages of all evening student-hours = 48·04%	42,094,312	—
SECTION B: SUBJECTS RELATED TO COMMERCE AND INDUSTRY		
1. Agriculture and Fishery	284,145	0·95
2. Nautical Occupations	37,859	0·13
3. Mining and Quarrying	399,383	1·34
4. Building and Allied Occupations	4,874,759	16·32
5. Manufacturing Industries	12,313,426	41·22
6. Book Printing and Allied Occupations	655,680	2·20
7. Commercial and Professional Occupations	10,899,443	36·51
8. Personal Services	397,069	1·33
Percentage of all evening student-hours = 34·08%	29,861,764	—
SECTION C: DOMESTIC AND WOMEN'S SUBJECTS		
1. Needlecraft	12,577,543	81·81
2. Child Care and Nursing	62,704	0·41
3. Other Subjects, including Cookery	2,735,694	17·78
Percentage of all evening student-hours = 17·55%	15,375,941	—
SECTION D: MISCELLANEOUS SUBJECTS		
1. Tutorial Classes and Individual Study	3,585	1·26
2. Other Miscellaneous Subjects	281,053	98·74
Percentage of all evening student-hours = 0·33%	284,640	—
GRAND TOTAL	87,616,657	—

A table can be abstracted under similar headings for Art Establishments from the Ministry's Report 1953, Table 45.

Students released from employment form the majority of students attending part-time day courses as shown in Diagram 7: the others attend courses of a general nature, or at any rate they are not specifically related to employment, though there is an undoubted vocational element in many of them. The modern jargon describes wives and mothers as 'not gainfully employed' but does not go so far as to say they are 'not gainfully occupied'. Many of them attend classes with keen enjoyment and satisfaction, and with great advantage to their homes (Chapter XI). Many adults, especially retired men and women, enjoy recreative classes in the afternoon and many more should be encouraged to develop new interests in life as in the notable experiments in painting classes (quite distinct from painting and decorating for home repairs) successfully made at the Southend-on-Sea Municipal College School of Art. Hidden talents, dormant for years, may be discovered resulting in keenest satisfaction and personal fulfilment; all the more reason for developing such leisure interests early, in evening classes and week-end activities (as in music and drama) during the student's working years.

Evening Classes

The diversity of technical education has been noted in Chapter I, and illustrated by reference to the range of subjects in evening classes as analysed in Table 11 [16]. Another table can be abstracted under similar headings for art establishments from the Ministry's Report 1953, Table 50. Such bare statistics can convey really very little of the rich diversity of human interests in these evening courses, and it would be easy to be statistically misleading by making further detailed analysis.

Many motives and purposes play havoc with statistical approximations, and it is impossible to draw any sharp dividing line between further education of direct use to the individual as 'economic man' or to the industry which employs him or her, and further education which could be classified as cultural or recreational. Table 12 gives summary totals of evening work in the three main kinds of institutions [17].

TABLE 12

ANALYSIS OF ENROLMENTS IN EVENING COURSES/CLASSES
(England and Wales 1952–3)

Institution	No. of Students who attended at any time in the Educational Year	Student Hours: Actual	Student Hours: Per cent. of Total
i. Major Establishments (other than Art)	700,158	44,797,382	47·95
ii. Art Establishments	92,508	5,840,680	6·25
iii. Evening Institutes	1,036,519	42,819,275	45·80
TOTAL	1,829,185	93,457,337	100·0

An amplification of line (i) of Table 12 for technical colleges only as in Table 11 is not available, but it would probably wear a more strongly vocational aspect in that Section B would account for a greater proportion of the whole, while in Section A such subjects as mathematics and natural sciences would again bulk more largely. Even so it would still be seen that the work of the major establishments (other than art) includes a great deal of truly general subjects and activities.

Evening classes are the oldest form of technical, or what we now call further education, and have always been subject to the over-riding necessity of limitation of time. How unfavourably evening classes are placed in this respect compared with other courses is shown in Table 13 [18].

TABLE 13

Average Student-hours of Attendance Per Annum in Various Courses [18]

	Course	Student-Hours	No. of Students	Approx. Student-Hrs. per annum	Ratio Between Courses
i.	Full-time	47,068,421	56,481	833, say 850	= 17
ii.	Part-time Day	54,044,031	353,049	153, say 150	= 3
iii.	Evening Courses;				
	Technical	44,797,382	700,158	64	
	Art	5,840,680	92,508	63	
	Evening Institutes	43,819,275	1,036,519	41	
	Total of all Evening Classes	94,457,337	1,829,185	51, say 50	= 1

Accepting for the moment the direct ratio 1 : 3 : 17 it is very clear that lack of time is the dominant factor in evening classes, especially in vocational classes directly related to employment. With leisure activities, particularly those which can be continued at home, the problem is different even though, at the risk of being sententious, we must add that there is never enough time for all that most of the students would like to do. If we examine the figures more closely we find a different emphasis, but not a radically different picture. We may take the full-time courses as basic and accept the ratio figure of 17. The part-time day figure is lower than might be expected, especially as most day release courses average about 220 hours per annum and there is comparatively little wastage. After making all allowances, the most optimistic overall ratio could be 17 : 4 : 2, which still points to the severe restriction of time in part-time day and especially in evening classes.

The reasons for the poor attendance of students at evening classes are all too easy to catalogue; the problem is what to do about them [19]. The following take their toll year after year with disheartening regularity; overtime, and being 'away on a job'; shift work or staggered hours; an indifferent or antipathetic firm which will not allow time off to get to a class on time; travelling difficulties, especially in bad weather; ill-health—both personal and in the family (which usually bears heavily on women and married students); lack of encouragement in the family, or simply home conditions which make it virtually impossible to do any homework or other study; changing from one job to another, inseparable from finding a suitable job at this age, and this may well happen part-way through a year. These test severely even the robust and purposeful students and soon dispose of their weaker brethren.

For those who escape these greater hazards there are still the subtler snares of life, which are hardly less potent deterrents to determined study; the counter attraction of dances, youth clubs, cinema and now television; the uncertain feeling due to an impending call-up for National Service; switching to a job with more immediate pay (with all that that means) and requiring less study and classes but, not unrelatedly, offering less ultimate prospects. Then there are undoubted academic reasons from 'not hitting it off with the teacher', or 'because no one seemed interested in anyone else' to 'I liked the engineering drawing, and even the science, but I couldn't understand the maths, not the way he taught it anyway' (a significantly defensive note). Against all this the older students are, by virtue of necessity, a highly selected group, but they have their own problems, with increasing responsibilities at work (which do not always wait upon the gaining of a Certificate). Family responsibilities play their part, though they can be an added incentive to become qualified.

All in all it is surprising, and gratifying, that so many persist to win through to a final achievement which can never be 'assessed' in marks. We must not overlook the disproportionate effect of—say—two absences, for the student soon feels it is hopeless to try to catch up. No wonder that many, if not most, colleges regard a student as having left after four consecutive absences, especially when solicitous postal reminders have elicited no response. This problem of catching up is the critical problem of the evening students, particularly if he has been somewhat ambitious in his commitments, either in the standard of the course or in the number of nights of attendance.

The arrangements for evening classes are not very complicated and follow a general pattern. The hours for holding them were made earlier during the war and, like theatre hours, have not fully returned to their former times. Related to this general practice is the earlier time at which normal public transport ceases to run. Most classes are held between 6.30 and 9 p.m. and most of them are of two hours' duration, usually from 6.30 or 7 p.m. Others directly linked with business on the spot, with travelling home to be done afterwards, may start at 5 or 5.30 p.m. Teatime classes for day-release students travelling from afar also are held from 5 to 7 p.m. Courses with a substantial proportion of practical work to be done generally have longer classes, frequently 6.30 to 9 p.m. and even 6 to 9 p.m. Such longer periods usually comprise a one hour lecture with practical work to follow. Problems at once follow where pressure of numbers requires two groups interchanging on the lecture room and the laboratory. A choice then may have to be made among several undesirable alternatives. For example, the lecture and laboratory periods each have to be 1¼ hours (even 1½ hours) with unwelcome reduction of practical work and undue extension of lecturing. We remember vividly a demonstration lecture about part-time teaching in which it was stated categorically that the desirable maximum for a lecture is 40 minutes and this particular lecture, proving this *inter alia*, lasted 65 minutes. After a day's work and travel, a 1¼ or 1½ hour lecture brings rapidly diminishing returns, especially in advanced work during the last period of the evening. Obviously the scope of already limited practical work is reduced still further. If the lectures are held to 50–60 minutes' duration there will be a double load on laboratory accommodation in the middle period, with all that that entails at the limit of capacity. Such problems are a commonplace, and indeed many a head of department would nowadays have a sense of wilful neglect if rooms were not continually used on this basis. After such conditions it is difficult not to feel that a room empty is a room idle, and become forgetful of the need for changing arrangements throughout the year, and a good degree of flexibility. The Ministry's Building Bulletin No. 5 recognised this inherent problem in technical work in assuming a two-thirds overall usage of accommodation to be reasonable [20]. In many colleges the present usage is far beyond this.

The more successful an evening class is, the more the students wish to stay behind to continue discussion. Some may find this is more likely with general subjects than with specifically scientific or technical subjects, though many would refute it; be that as it may, all teachers with such students would agree on one thing. Nothing is then more infuriating than to be made acutely aware of the fact that 'the caretaker is waiting', and have either to foreclose the discussion or try to continue it outside. It may be the caretaker's conditions of service or his outlook and temperament, but whichever it may be, it is exasperating to be expected to depart quietly with an apologetic air for having used the place at all. As for life's troubles, anyone engaged in evening class work in someone else's building knows they crop up from time to time. Problems of joint usage, as in evening use of a day school, apparatus not put out or not put away, damage to furniture and apparatus and so forth—can be magnified by ill-will to such a degree as to make one wonder whether both day and evening education can be part of the same service at all. Fortunately they are very few and the impression is that they are fewer than formerly.

Many technical institutions have grown from small beginnings in evening classes in other buildings and the link is long retained. Moreover, as the College grows apace it is found desirable to place still more evening classes in nearby schools and then a variety of arrangements may obtain, broadly summarised in Table 14.

TABLE 14

TECHNICAL COLLEGES AND EVENING INSTITUTES; ADMINISTRATIVE RELATIONSHIPS

i.	Total number of colleges surveyed	184
ii.	Number with Principal fully responsible for the related evening institutes	41
iii.	Number where Principal has limited responsibility	15
iv.	Number where Principal had no administrative responsibilities but is consulted about general arrangements	19

Over three-quarters of the colleges listed in line (ii) of Table 14 are small institutions.

The range of standard of courses available in evening classes is very great, reaching from very elementary courses in general education and technical skills up to final professional examinations, particularly in commerce and technology, final degrees of London University, and beyond to post-graduate or post-advanced refresher and intensive courses, even research, and yet again to courses in management at various levels. If in the main the conditions of time and place are so arduous that good work is done despite them, good work is nevertheless done. This must be emphasised for there are two opinions which need to be combated; both stem from a laudable desire to improve the lot of students, but both suffer from an unreasonable over-emphasis. The first is that evening classes are so arduous, so limited in scope and have so many inherent defects that though they are better than nothing under duress of circumstance, in a reasonably planned economy they would vanish altogether in favour of daytime education. Quite apart from the feasibility of endlessly extended education, this wholesale condemnation is also unrealistic in ignoring the great increase in people's leisure time in the last few decades. It is a good thing for people to use a reasonable part of their leisure time to attend evening classes whether for purely leisure interests or for vocational purposes. No one keenly interested enough to do so should be denied the opportunity, nor should their attendance and attainments necessarily be judged by the same criteria as apply to full-time and part-time day-release courses. There is a further point in that certain interests and activities become significant or compelling only as we grow older whether this be, for example, homecrafts or politics and local government, or yet again music and drama, literature and psychology, indeed the whole range of adult education howsoever interpreted and arranged.

The second opinion would allow of evening classes on a broad basis but would deny to them any possibility of high standards in depth of treatment and understanding. There is, of course, some truth in this for young students in employment, pursuing advanced courses for example in science or one of the technologies, who must often plan their studies on the minimum requirements to pass the examinations (an aim not unknown among full-time students who have a wide range of other interests). It is true that evening classes no longer suffice for certain studies, e.g. in science and engineering (even though very bright students occasionally still obtain first class degrees this way) and all students able to profit by such studies should have daytime education. Nevertheless there are many evening courses in which very high standards are achieved and which remain of great significance to the more mature student. In these the actual class becomes, not the time and place for 'doing all the work' but the point of focus and illumination of the student's experience and of his reading and reflection in his own time.

Intensity of illumination not extension of exposure in prolonged class hours is the necessity of the evening student—an inescapable challenge for the average class and the teacher. This is the real argument in favour of the occasional lecture by the eminent scholar, by the original worker, the explorer and discoverer. Intensity of experience, a feeling of being a fellow worker or student (no matter how humble his part), linked with a motive, can work wonders, and indeed has done, as the record of good teachers and their students has proved over so many years. The need will always remain as well as that for a devoted evening staff. As full-time secondary and further education has increased, and part-time day education also, so there has been a consequent increase in evening classes. Indeed the state of voluntary evening classes could well be a diagnostic of the health of the main educational system, and we can well look forward to their continued increase and importance.

Range and Quality of Courses

We need now to look somewhat more closely at the range of courses and their quality as determined by accepted methods of certification. In general leisure activities do not have any system of examination and certification. Put that way it seems absurd but many students are not averse to examinations, but rather welcome some defined incentive, with the added self-respect it brings. For example it is by no means unknown among students taking languages for pleasure and the prospect of travel.

The great bulk of the work in technical and commercial colleges and, to a lesser degree, in the colleges and schools of art, is however in well-defined courses over a number of years, with the award of certificates at various stages. As shown in Diagram 12, an Intermediate Certificate may be awarded at the end of two years and a City and Guilds of London Institute Final Certificate at the end of four years (p. 150). Other courses, depending on the complexity of the skill to be mastered and on other factors, may have an Intermediate at the end of three years and the Final at the end of five years. Again, other technical courses lead to the award of National Certificates awarded jointly by the professional institutions concerned and the Ministry of Education (p. 154), with the Ordinary Certificate (O.N.C.) generally at the end of three years and the Higher Certificate (H.N.C.) at the end of a further two years, with additional subjects or 'endorsements' at the end of another year. Alternatively the Higher Certificate may be organised on a three-year basis to include the endorsements required for exemption from the examination of professional institutions. The full-time analogues of the National Certificates are the National Diplomas at the Ordinary stage after two years (O.N.D.), or the Higher Diploma (H.N.D.) awarded after three or four years depending on the starting standard.

Final Degree Courses of London University are available, both full-time and part-time, and the other major group of qualifications available are those obtained through the examinations of the professional institutions, as in architecture, chemistry, physics and the business professions. We may thus have a 'course-work profile' of an institution shown in Diagram 13, on similar lines to the work-profile shown in Diagram 4 (p. 77).

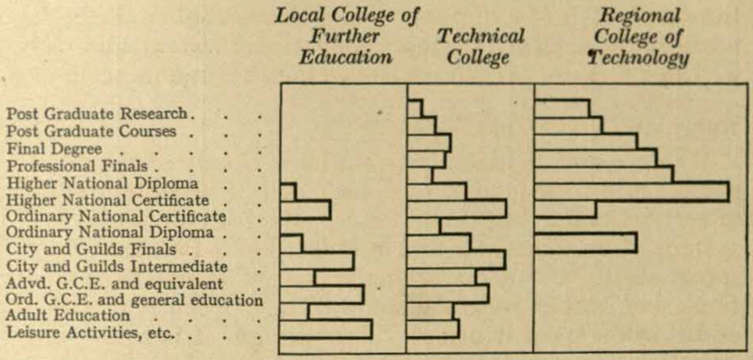
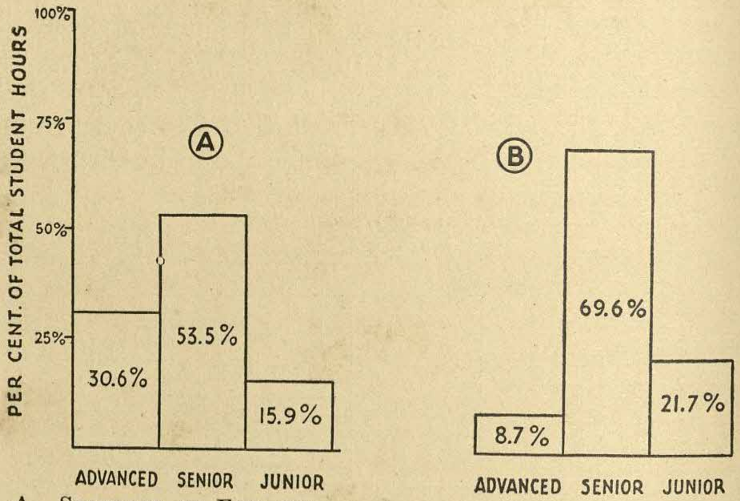


DIAGRAM 13. COLLEGE COURSE-WORK PROFILES

'Course-work' profiles do give an impression both of the range and quality of work carried on in a college, but the aspect of quality may be emphasised by an analysis of enrolments in different grades of courses. This is given in Table 15, in which advanced courses are beyond Ordinary National Certificate, Intermediate Degree, G.C.E. Advanced Level or equivalent standard; senior courses comprise the three years for O.N.C. or for Advanced G.C.E. for Intermediate Degree or equivalent [21].

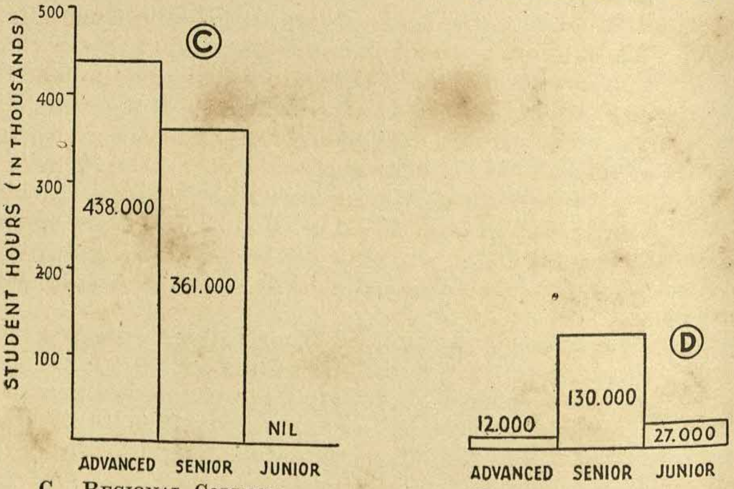
Art Colleges have been omitted from Table 15 as it is not possible to compare their work in the same terms. The most outstanding fact which is least widely appreciated, especially in academic quarters, is that there are nearly 12,000 full-time and over 32,000 part-time day students attending courses of university degree and equivalent standard (lines 2, 5 and 7). This is of great significance in higher technological education (Chapter XV) and also in the matter of grants to students (p. 525).

Table 15 gives the overall national picture, which should be compared with Diagrams 14*a* and 14*b*. There is great variation between individual colleges and a broad distinction between regional and local colleges. The former tend to be larger in



A. Standard of Full-time Courses
(England and Wales, 1952–3)
Major Establishments except Art

B. Standard of Part-time Day Courses
(England and Wales, 1952–3)
Major Establishments except Art



C. Regional College

D. Local College of Further Education

DIAGRAM 14. STANDARDS OF DAY COURSES

Source

The Diagrams are based on information of A.T.I./A.P.T.I. Institutions supplied by the Ministry, but description C Regional College is the author's not *the Ministry's* size than the latter, but this may cease to be generally true as they shed their lower levels of work to the local colleges. Even at present they have a greater proportion of advanced work, as shown in Diagrams 14*c* and 14*d*, and this will become accentuated as the transfer of work progresses.

TABLE 15

ANALYSIS OF STANDARDS OF DAY COURSES
(England and Wales 1952–3)

	Number of Students					
	Advanced		Senior			
	University	Non-University	University	Non-University	Junior	Total
1. *Full-time Courses*	4,736	7,150	3,320	21,334		
2. Total Main Sections	11,876		24,654		8,209	44,739
3. Per cent. of full-time Total	26·6%		55·1%		18·3%	100%
4. *Part-time Day Courses*	6,443	26,088	5,765	229,875		
5. Total Main Sections	32,531		235,640		84,769	352,940
6. Per cent. of part-time Total	9·2%		66·8%		24·0%	100%
7. GRAND TOTAL	44,407		260,294		92,978	397,679

The individual enrolments of colleges are given in Appendix, pp. 587–602, but these cannot measure the quality of work or the variation as exemplified in Diagram 14, or that indicated in Table 15. The question of whether any relationship exists between the size of a college and the quality of its work, the care of its students and its corporate life is a very interesting one with important administrative consequences dealt with in Chapters XVI and XVIII. Unless these are dealt with, a college doubling in size may well become twice as weak, not twice as strong or twice as good as is so often assumed must be so.

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CHAPTER V

PARTNERSHIPS IN TECHNICAL EDUCATION

THE success of technical education is made possible only through a wide variety of living partnerships at various levels and concerned with differing aspects of our work and administration. As in the rest of life the practical meaning of partnership goes far beyond any legal bond; some are very old, some new, some follow accepted established forms while others are experiments to meet the compelling urgency of new industrial and social conditions. Running through all are three essentials, administrative, industrial and academic, and all must be preserved in balance if satisfactory harmonious progress is to be made.

The administrative aspect is seen in providing the right means of stability and development for the level of education concerned. For example, at the moment there is a great controversy as to whether the administrative means and procedures employed for local technical institutions are equally appropriate for major institutions (Chapters XV and XVI). By the industrial or commercial aspect is meant the way in which the needs of industry and commerce are met by their representation on bodies concerned with technical education, both administrative and academic. At the regional level are the advisory councils and academic boards, and the individual colleges have their advisory committees. The academic aspect is seen in the devising of courses and their syllabuses, in the determination of standards by appropriate examinations and certification. Thus we find a complex structure of examining bodies, regional examining unions, professional institutions, Joint Committees for National Diplomas and Certificates, University External and Internal Degree relationships and so forth.

Inevitably certain policy considerations, as in higher technology, and value judgements, as in academic matters, will arise in presenting the facts of this complex structure. For example, some partnerships are so unequal in character as scarcely to warrant the appellation at all, especially in academic matters, where work without representation is still expected from the technical colleges in some quarters which ought to know better.

Before proceeding to detail, we may stress the very high proportion of voluntary interest and activity which these partnerships display. This does not vanish because some suitable statutory instrument is provided, as for example in the governing body of a college, or a formal instrument as in teacher representation on the sub-committees of a regional examining union. In these and in so many other cases time, thought and energy are given selflessly and enthusiastically for the ultimate good of students. Some advocates of adult education would perversely deny the appellation 'voluntary' to the work of those engaged in further or technical education. Apparently if a student undertakes vocational studies he must do so compulsorily; if a teacher spends time outside his normal hours in various committees, or within them so that he has to catch up on his normal work some other time, he cannot possibly be undertaking all this voluntarily. It seems to be implied that unless a student voluntarily attends a three-year tutorial adult education course, he cannot possibly be educated at all. To deny the willing and voluntary nature of much of further education, including technical, is to abuse the language and be unjust to those engaged therein.

Governing Bodies

There are regrettably still a number of colleges, including large ones, without properly established governing bodies, and therefore they lack that direct interest and support which a responsible governing body can give (pp. 484 *et seq.*). In general, the less the delegation of responsibility by the local authority, the poorer is the expression of its partnership with industry and other interests. Among the elected governors there are many engaged in industry and commerce, who quite naturally keep this aspect well in mind. Nevertheless there is a strong advantage in having direct representation from industry and commerce at governor level, which is conceded in the constitution of many governing bodies. But the representation is generally only a token one, usually one representative of the employers' organisations and one of the employees' trades unions. What the proportion should be is still a debatable question (p. 501).

The representatives of industry and commerce are gathered preferably on the nomination of various employers' federations and associations and of the relevant trades council and similar organisations. There is advantage too in spreading the types of representation in the governing body, to give the college good roots in diverse fields of interest, and to prevent one interest becoming dominant to the detriment of the collective wisdom of the body as a whole.

Other representations on governing bodies include those of the universities, the professional institutions and of the college advisory committees. Numerically, university representation on the governing body is not likely to be large but qualitatively it can be of great value. If the representative is concerned specially to see that all is done to assist the principal and staff to raise educational standards and so have standards of provision raised for them in order to do this, then indeed this independent qualitative contribution is to be welcomed. Representatives of professional institutions most closely concerned would be helpful as they would also provide an additional assurance of high standards. Another desirable arrangement is to have the chairman of each college advisory committee as a member of the governing body, either directly by virtue of that office or as a co-opted member. He is then able to present the recommendations of the advisory committee in person and emphasise the necessary industrial and technical aspects of the matter under consideration. With a large number of advisory committees (p. 134), some other arrangement would be necessary to prevent an undue proportion on the governing body. In one case the chairmen serve on the governing body each for a period on a rota, but clearly each cannot present the arguments of other committees.

That college thrives best whose governing body is a true partnership dedicated to fostering its work. With warring interests and clashing personalities, the results will satisfy no one and benefit the students least of all. The principal and staff are servants of the governing body in the legal sense, but in the best instances this does not preclude a real sense of partnership with the governing body in a fine and lively enterprise.

Advisory Committees

These are a feature of technical education though not on the scale generally imagined, and there may still be some confusion about their functions. There is the cautionary tale, presumably apocryphal, of a principal who worked for years to persuade his governing body to establish an advisory committee. This they were very hesitant to do, thinking it to be a potential limitation of their powers of governance. Being at length persuaded—let no one say cajoled—into this course of action, the first advisory committee was established. Sad to relate it met but once, for it advised the removal of the principal.

In many cases advisory committees are formed when the need is apparent and when there is likely to be a sufficient volume of support forthcoming. Sometimes, when a problem arises concerning a particular course or a particular industry, a small panel is found consisting possibly of two governors, and a few representatives of the employers and employees. Such panels are quite adequate for dealing with specific problems as they arise, for once agreed in principle by the governors they do not require much formal treatment, nor the periodic calling of meetings. Where there is a large number of courses with which industry is closely concerned, and especially where conditions in the industry and in college and in the content of courses are rapidly changing, it is better to have a fully established advisory committee with proper terms of reference. Experience has shown the following terms of reference to be very satisfactory:

1. To advise on existing and proposed courses and syllabuses in those branches of study covered by their designation in order to ensure that the work of the college and equipment provided are in harmony with the best practice of industry and commerce.

2. To serve as contacts between the college and industry and commerce and to encourage co-operation between employers' and employees' organisations and the college; and generally to assist in making the work and facilities of the college better known in industry and commerce.

3. To facilitate the work of the college through the representation of appropriate recognised professional institutions.

4. To advise and assist in:

   a. the recruitment of students for courses, especially part-time day classes, 'Sandwich' Higher National Diploma Courses and other courses in advanced technology.

   b. the placing of students, more especially those of the full-time courses, in suitable posts.

   c. the recruitment of part-time visiting specialist teachers from industry and commerce, required for teaching part-time day and evening classes.

5. To be instrumental in securing gifts to the college of equipment and materials, and to facilitate the loan of special items of apparatus of machinery to the college.

6. To assist in the development of research work in the college and especially into technological problems.

7. To establish, where desirable, special prizes and other awards with the object of encouraging capable and deserving students.

On the question of what is a suitable constitution for an advisory committee, a survey of colleges shows a great variation from a simple constitution comprising governors, employers' and employees' representatives, to some three or more other categories than these. Some examples are shown in Table 16.

TABLE 16

COLLEGE ADVISORY COMMITTEES

EXAMPLES OF DIFFERENT CONSTITUTIONS

	A	B	C	D	E
Governors	3	6	1	7	3
Employers' Organisations	12	4	5	5	3
Employees' Unions	11	4	2	3	2
Professional Institutions	1	7	12	1	—
Research Associations	—	1	—	—	—
Co-opted Members	3	2	—	2	5
Ministry of Education	1	2	—	—	—
TOTAL	31	26	20	18	13

If the chairmen of the advisory committees do not serve on the governing body, governors should be on the advisory committees (perhaps in any case). These governors will then hear the representatives of industry and commerce making their views known and will be able to report directly to their fellow governors; the principal will not then be open to the suspicion that the advisory committee minutes are but a disguised section of his own report to the governors. In the above table Committees B and D have possibly too many governors, four would be sufficient; Committee A has too many representatives of employers and employees, and the best maximum total number is probably not above 20.

A is a building advisory committee in a medium-sized college. B is an engineering advisory committee in a large college in a heavy industrial area, and the professional bodies represented are the Institutions of Civil Engineers, Mechanical Engineers, Electrical Engineers, Structural Engineers, Production Engineers, Gas Engineers respectively and the Royal Aeronautical Society. Few colleges are within easy reach of the headquarters of professional institutions but the professional institution can nominate one of its senior members of high standing in local industry, after obtaining the advice of the particular branch of the institution. The committee with the constitution C is in a large commercial college which provides many professional courses. Committees D and E are both concerned with printing; D with one special aspect of printing in a major college devoted to printing only, whose governors have an immediate technical interest in the work, while E is for printing generally which is only a section of work in a much smaller college.

In a very few cases representatives of large firms are invited as such, but with the difficulty of drawing a line and the possibility of generating ill-will it is better to cover such representations as co-opted members. Very few advisory committees list a representative of the Ministry of Education in the constitution of the committee. This may be because it is thought that Her Majesty's Inspectors cannot be members of the committee, but they may attend as assessors and for all effective working purposes, except voting, the result is just the same. From the college standpoint their presence can be very helpful, for whatever may be the legal and administrative responsibilities of national and local government (p. 481), H.M.Is. do establish a real working partnership in these committees. Not all is perfection owing to personalities involved —on both sides, for there is no professional distribution of original sin—but if the H.M.Is. are omitted the loss is mutual and unfortunate.

The reason for this somewhat lengthy treatment of advisory committees is partly that they are effective at the growing point of work within colleges, and partly because it seems that many more colleges might establish them. Out of 195 institutions 131 have no advisory committees though in eight they are being considered. Now it would be foolish to assert that all colleges should have them or otherwise they could not be efficient, but the number without seems much larger than it ought to be. Some institutions are too small and/or insufficiently specialised to warrant advisory committees, and at most *ad hoc* panels would suffice to meet their needs. If the total is reduced by half there would still be about 60 institutions which ought seriously to consider establishing such committees, or at least to make sure that they are securing the aims listed under the terms of reference so fully as to render advisory committees superfluous.

In the remaining 64 colleges there are 263 advisory committees, but there is a wide range in numbers as shown in Table 17.

TABLE 17

ADVISORY COMMITTEES IN COLLEGES

No. of Committees	1	2	3	4	5 or more	5	6	7	8	9	10	13
No. of Colleges	9	9	9	14	23	8	8	1	3	1	1	1

Proliferation of committees produces problems of its own (which is typically English meiosis in this committee ridden age), and eight or more committees can hardly meet as frequently or undertake as much work as four. They serve more as panels for departmental heads of departments, which is a legitimate function but not at the level of a college advisory committee. A good arrangement is for the advisory committee to meet twice a year or more often if required as, for example, for special consideration of their part of new extensions. A meeting in late October to early November gives an opportunity to assess current problems arising from the year's enrolment, and a second in June–July can look at the year's work and try to anticipate trends for the following session.

The most widely taught subjects not surprisingly have most committees, thus: engineering (53); building (44); commerce and retail trades (26); science and pharmacy (18). Post-war, there is a new emphasis, as in bakery (14), catering (13), administration and management (5). Advisory committees are also held for 42 other subjects including such diverse ones as mining (11), textiles (8), women's work (7), marine and navigation (3), plastics (2), librarianship (2), dental technicians (3), printing (5), hairdressing (4), boot and shoe (3), foundry and patternmaking (2), brewing (2) and meat trades (2). Advisory committees have been established for non-vocational activities as for drama (2), music (1) and there is one known as 'non-vocational' with six governors and seven representatives of local clubs, associations and adult education organisations.

Regional Advisory Councils

The college advisory committees are designed to foster the interrelatedness of college and industry, but the disposition of industry knows no local authority boundaries and may involve large areas and many colleges. At 'area', 'regional' and 'national' levels advisory councils have been established to deal with the problems involved. The problems are not new nor is the solution, though both have received much greater attention since the war. The idea of bringing regional considerations to bear on the organisation of technical education first received official advocacy when Lord Eustace Percy was President of the Board of Education and Mr. A. Abbott was Chief Inspector of Technical Education. One of their actions was to arrange a survey by H.M. Inspectors of further education in the geographical county of Yorkshire for the session 1925–6. The survey was published in 1927 and considered at a conference of representatives of all the local education authorities in the county with the Universities of Leeds and Sheffield, and Hull University College, held in York on 30th April, 1928.

From its beginning at this conference the Yorkshire Council for Further Education has exercised a profound influence on technical education in Yorkshire without entering into the field of examinations [1]. Principally this has been because it based its activities on industrial advisory committees on each of which the employers and operatives in the industry concerned had a controlling voice, and on area committees which gave an opportunity to the smaller institutes to bring their point of view to bear on policy. Between 1929 and 1939 two more surveys by the Board of Education, in the South Wales coalfield and in the West Midland metal working areas respectively, led to the establishment of regional advisory councils in those areas, and a series of local surveys in Lancashire sponsored by the Lancashire County Council were followed by the setting up of a Manchester and District Regional Advisory Council. A Merseyside Council was planned but was not fully operative when war broke out. There was also the important report of a conference in 1937 of representatives of the Association of Local Education Authorities and the London County Council.

After so long a preparative stage the war changed the pace and scale of development very markedly and not least because it made plain certain deficiencies which in terms of national survival could no longer be tolerated. Hard upon the passing of the Education Act a Select Committee was appointed to consider 'Higher Technological Education and the respective contributions to be made thereto by Universities and Technical Colleges', for at the higher levels of work the issues are critical and far transcend the immediate localities of any one college. This Committee, under the Chairmanship of Lord Eustace Percy, in its published Report [2] in 1945 devoted a section (IV, §§ 33–39) to these questions and recommended the establishment of eight Regional Advisory Councils, and related Regional Academic Boards, to cover England and Wales, and took special note of the position of Scotland and of London and the Home Counties. These recommendations of the Percy Committee Report were quickly embodied with minor modifications in the Ministry of Education Circular 87 (issued 20th February, 1946). The Circular suggested nine Regions for England, with a tenth for Wales and Monmouthshire, and wisely concurred with the Report that 'all schemes of regional organisation need not follow one and the same pattern in all particulars'. Such an un-English standardisation was never likely, and only the broadest pattern is discernible in the constitution of the Regional Advisory Councils, which are set out in Table 18.

TABLE 18

CONSTITUTION OF REGIONAL ADVISORY COUNCILS
(England and Wales)

Representation	Region (see Appendix, p. 614) 1	2	3	4	5	6	7	8	9	10
Local Education Authorities	18	26	30	31	28	26	35	52	42	84
University	5	6	4	10	7	2	6	10	2	5
Industry and Commerce	6	8	6	18	13	12	12	15	6	4
Principals of Technical Colleges and other Establishments of Further Education	3	10	15	16	11	16	13	13	9	11
Teaching Staffs of Same	2	—	—	4	3	—	1	7	4	
Adult Education	—	4	—	—	—	3	1	12		
Other Categories	1	4	2	—	4	7	13	18	6	5
Co-optative (max. no.)	—	6	2	6	5	—	1	7	6	3
TOTAL	35	64	59	85	71	66	82	144	75	112

(1) London. (2) Southern. (3) South-west. (4) West Midlands. (5) East Midlands. (6) East Anglian. (7) Yorkshire. (8) North-west. (9) Northern. (10) Welsh Joint Committee.

Representatives of various Ministries, Education in all cases, and in some, Fuel and Power, Agriculture and Fisheries, Labour and National Service, appear as non-voting Assessors and are included in the foregoing totals under Other Categories.

That the London and Home Counties Region should require a Council of only 35 members while another requires as many as 144 is very surprising and betokens a very different approach, assuming the regions to be at all comparable in complexity and structure. Of all the advisory councils only that for London and the Home Counties is specifically restricted to Higher Technological Education; seven cover Further Education; one Technical, Commercial and Art Education, and the Welsh Joint Education Committee is for Technical Education and Further Education. Some are representation run riot, with everything but the kitchen stove. The Councils have met at regularly appointed times since their establishment, but one wonders with what congruity of interest and consequent effectiveness in most cases over so wide a field. In short, are they in fact real effective partnerships or is the Regional Advisory Council merely a combined superstructure supporting largely unrelated sectional interests? In this connection the analysis of members' attendances would be revealing, for an all embracing body is apt to be self-defeating.

The Percy Committee Report recommended Regional Academic Boards of Advanced Technology and this was accepted in § 9 of Circular 87, and their constitutions, as set up, are shown in broad categories in Table 19.

TABLE 19

CONSTITUTIONS OF REGIONAL ACADEMIC BOARDS

	Region (Appendix, p. 614)									
Representation	1	2	3	4	5	6	7	8	9	10
Local Education Authorities	9	13	10	6	6	7	13	5	6	6
University(ies)	6	6	4	5	7	2	8	20	12	6
Industry and Commerce	6	2	—	3	8	6	13	10	7	6
Principals and Technical, Commercial and Art Institutions	12	9	24	15	19	3	7	25	16	5
Teaching Staffs	9	2	2		2	11	6	8	5	1
Other Categories	2	3	1		2	2	1	4	2	1
Co-optative	—	—	—	—	—	—	3	8	—	2
TOTAL	44	35	41	30	44	31	51	80	48	27

(1) London. (2) Southern. (3) South-west. (4) West Midlands. (5) East Midlands. (6) East Anglian. (7) Yorkshire. (8) North-west. (9) Northern. (10) Welsh Joint Committee.

Note (*a*) Two Area Technological Sub-Committees have been established in Region 6 instead of a single Academic Board; the constitution given is that of the Eastern Area.

(*b*) There are two Academic Boards for Leeds-Hull and Sheffield areas respectively; the constitution given is for the Leeds-Hull area of Region 7.

Both the advisory councils and the academic boards work mainly through appropriate standing sub-committees, which are usually related to particular industries and subjects, and additional specialists and experts are co-opted thereon either permanently or *ad hoc* for single enquiries. In this way detailed specialist consultation precedes the determination of policy, or rather, advice is made available to the particular authorities concerned, which will certainly be taken note of by the Ministry's representatives.

The regions differ considerably in their geographical necessities and distribution of industry. Thus some regions have the structure outlined whereas others have area or district councils, which in their turn may have a similar structure of appropriate specialist sub-committees. In Region No. 8 the structure is as shown in Diagram 15.

Limitations of space in Diagram 15 prevent all sub-committees of all area councils being shown and also the various cross-linkages and flow of reports between related sub-committees. The pioneer work in the north-west was done by the Manchester and District Advisory Council and it now appears to be greatly diminished in the total scheme. In point of fact its work is increasingly successful especially in the post-advanced subject committees. At this level with this long experience, there is a more direct sense of the problems and of

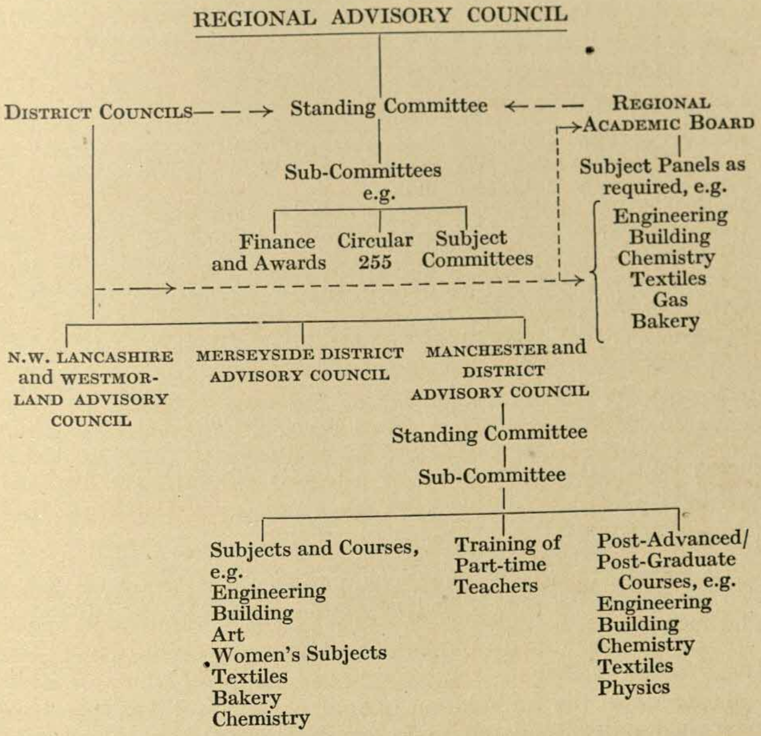

DIAGRAM 15. ADVISORY COUNCILS AND COMMITTEES IN THE NORTH-WEST REGION

partnership in fostering the work of colleges and supporting new experiments. The college advisory committees are at the 'working-face' of technical education, the district advisory council committees give full support in the rear, while the regional bodies in comparison appear very remote and very much on the surface of things.

Certainly the Regional Advisory Council structure is imposing and covers the ground, but is it effective in tackling the problems, real and imaginary, laid at its door? 'It is always a little difficult to catalogue the *achievements* of an advisory body. We advise and other people execute. Strictly speaking the achievements are those of the local authorities and colleges however much they may have been inspired by the Council's recommendations and reports or, as very often happens, merely by discussions in our committees. Very broadly, what we seek to do is to equate the regional needs of industry and commerce to the regional provision of technical education' [3]. The essential tasks of the Regional Advisory Councils may be summarised thus:

i. *Educational*

a. to survey existing provision of normal courses and subjects, and research.
b. to formulate recommendations to make good any deficiencies and to prevent wasteful duplication.
c. to formulate recommendations of special post-advanced/post-graduate courses in higher technology, including management.
d. to encourage the holding of training courses for part-time teachers.

ii. *Publicity and Dissemination of Information*

These are a necessary consequence of work satisfactorily completed under (i) and take the form mainly of brochures, leaflets and guides.

iii. *Administrative Matters*

To formulate recommendations on such matters as extra-district payments, part-time teachers' salaries, fees for full-time and part-time courses.

iv. *National Policy*

To assist in the formulation of national policy by forwarding recommendations and reports to the National Advisory Council and the Ministry of Education.

In practice there is a great variation in performance in the different sections especially i. to iii. Some have published little, others a great deal; some have not tackled part-time teachers' salaries and/or training courses, some have made recommendations which have been accepted throughout their region. How far these variations are due to local circumstances, e.g. the prior existence of some other body to deal with the problems involved or geographical factors which are very difficult to surmount, only a detailed investigation in the region can decide. One thing is clear, that the variation between regions is sufficiently marked as to provoke the idea of a detailed critical examination of the work of the regional advisory councils and academic boards and their numerous committees, at the end of their first decade in 1955–6. There is a big difference between the initial tasks which faced most of the councils, as inherited from former days and as the immediate result of the war, and what is likely to be their continuing work once the first urgent phase is past. Need the councils be so large and the committees so numerous for this second phase, a point of some consequence when the annual net cost in England is now about £32,500. Though the emphasis will change on tasks i. and ii., the tasks will not vanish; nevertheless the change in scale and emphasis may very well be sufficient to warrant worthwhile re-organisation and reduction in size.

At the apex of the advisory council system is the National Advisory Council on Education for Industry and Commerce established in December, 1947 [4]. This is another body formed on 'the all-in representative basis' on the assumption that a large partnership of interested persons would be better than a small body which would impartially review the problems after consulting those vitally interested. Its constitution is given in Table 20 (see also Appendix, p. 614).

TABLE 20

CONSTITUTION OF THE NATIONAL ADVISORY COUNCIL ON EDUCATION FOR INDUSTRY AND COMMERCE

Chairman—appointed by the Minister	1
Local Authorities' representatives	11
Universities' representatives	10
Teaching Staff representatives	11
Representatives of Employers	10
Representatives of Employees	10
Nominees of the Minister	20
Assessors to the Council	8

Of the 72 members, 52 representatives are appointed by the Minister on the nomination of the ten Regional Advisory Councils for Further Education in England and Wales. The Council has been almost wholly preoccupied with problems of higher technological education and its Report and the subsequent White Paper are dealt with in Chapter XV. Its most important recommendation to date has led the Minister to agree to the establishment of a National Council for the award of Diplomas in Technology (p. 578).

The Advisory Council for Wales, established in 1944, takes the form of a Joint Education Committee, which is summoned to meet quarterly. The constitution of the Welsh Academic Board of Technology is now under review with a sensible total of some 25 members in mind and equal representation of the University of Wales, the Technical Colleges, Industry and the Welsh Joint Education Committee. The Joint Committee is unusual in undertaking the examination of students in technical institutions; this covers both the organisation of assessed examinations for the internal School Leaving Certificate of Junior Technical Schools, and the preparation of syllabuses and conduct of external examinations for Ordinary National Certificate schemes.

In Scotland five advisory councils were established in 1949 for technical education only (Appendix, p. 615). Their constitutions follow much the same pattern as in England with representatives of education authorities, universities, industry and commerce, but differ in reflecting the different organisation of higher technological education in Scotland [5]. Thus the direct grant central institutions have their own representatives (a governor and the principal in each case) on the council, a right and a recognition which does not pass unnoticed by those in comparable institutions south of the border. Since their institution the councils have examined, mainly through specialist sub-committees, the provision for technical education in their regions in the light of local industrial conditions and of probable developments.

As in England the history of such co-operation goes back much further than the establishment of advisory councils to cover the whole country, though here again there is a difference in that the regional organisation was designed to lead students towards a single institution. The West of Scotland Joint Committee for the Organisation of Classes in Science and Technology, representative of educational and industrial interests, was set up in 1901 to ensure that part-time elementary technical education in local centres led to more advanced classes provided in the Royal Technical College, Glasgow. Recently on the advice of the Regional Advisory Councils concerned, similar joint committees have been established in South-east Scotland (centred on Edinburgh) and North-east Scotland (centred on Aberdeen). Here too examining functions are assumed by the Regional Advisory Body [6]. Scotland shows extreme contrasts in the work, actual and potential, of advisory councils, varying from one centred on a very important industrial region, such as Glasgow and South-west Scotland, to that covering the Scottish Highlands and Islands.

In the latter area there is 'no university, central institution or institutes around which to develop' and 'the complete lack of a tradition of technical education in the Highlands will not be rectified by short term policies' [7].

In addition to the Welsh and Scottish examples already quoted, the Yorkshire Council for Further Education has also acted for the last three years as a Regional Examining Body for Mining Education. These instances provoke the question as to whether the two separate functions of advisory council and examining body ought to be combined. In some regions historical precedence has prevented this, for example in the North-west where the long-established Union of Lancashire and Cheshire Institutes wholly precludes the advisory council considering the question at all. There is here a common secretariat as in a few other cases and while there was some initial resistance to this arrangement, it has worked satisfactorily. The personnel are common to many of the advisory committees of both bodies, and their work is so interrelated that there is some advantage in having a common secretariat. The only danger in an advisory council exercising examining functions is that it may by its influence (which can be powerful enough though remaining advisory) compel an institution to accept the examining function as well and forego its own examinations and schemes. This is a point no major institution could ignore, but so far the possible unfortunate implications for the academic autonomy of major institutions remains remote.

Examinations: The Work of Professional Institutions and Examining Bodies

Much is said nowadays of the tyranny of examinations, and in particular of 'the thraldom of the London University External Degree System' [8]. There is much indeed to be said on both sides but, no matter what our present changed ideas on the desirable degree of academic autonomy may be (Chapters XV and XX), we cannot foresee a future without examinations and must concede the valuable stimulus they have provided to technical education in the past. Indeed they have had a profound effect on the standardisation of college courses, in providing powerful incentives to further study, and in providing recognised qualifications for the selection of teaching staff for a wide variety of technologies. In the growth and conduct of these examinations there have been three main parties—the professional institutions, the various examining bodies and the Ministry of Education, formerly the Board of Education [9].

We cannot here consider the nature and function of professional institutions, a topic of far-reaching importance still being actively considered in many quarters and especially in regard to the distinctions between professional and trades union outlook and responsibilities, and their changing function and significance in a modern state with nationalised industries and occupations [10]. 'The history of the professions is the history of specialisation—and of the realisation that breadth of experience, liberality of education and understanding of fundamentals must somehow be preserved in professional training if the specialist is to be adequate to his task' [11]. Such specialisation is in part examinable and in part to be specified and acquired only in terms of appropriate experience and sufficient degree of responsibility in the practice of professional work. All major professional institutions require standards of admission by their own examinations or equivalent ones (e.g. Degrees, Higher National Diplomas and Certificates) to the various levels of membership. Through their examinations and the prescription of approved syllabuses of study, the professional bodies have exercised a profound influence on the growth and orientation of technical education and in three main ways [11*a*].

The first is in the conduct of their own examinations which, if the professional qualification is of high standing or, more, if it is a statutory qualification to practice, is bound to have as direct and powerful an influence as the London University External Degree System.

Where the professional qualification is required by the student for his future career, the college courses must approximate closely to the prescribed syllabuses and very little academic autonomy remains to the college. The closer the approximation the more the students will be pleased; the college must then distinguish itself by the quality rather than the content of its teaching. The position is not quite so rigid if the published syllabuses are not in great detail, but even then they acquire a more restricted scope in the light of past examination papers, which are closely studied by staff and students alike. Such an academic arrangement has nothing of the nature of a partnership unless as sometimes happens, representatives of the technical institutions serve on the education and examining committees of the professional institutions, and help in the drafting of syllabuses and in the general conduct of examinations. In most cases there will be technical college teaching staff in membership of the professional body, who may come to serve in the same way as their non-teaching colleagues. They may be specially chosen within the professional institution for this reason, or the A.T.I., A.P.T.I. and A.T.T.I. (pp. 163–5) may be asked to nominate some representative to the education committee of the professional institution.

The second arrangement is more acceptable to the colleges. In this the professional institution inspects the technical institution regarding the staffing, accommodation and equipment for the particular courses. If these are satisfactory then the technical institution is recognised for the purpose of educating students of the profession and preparing them for the prescribed examinations at different levels. Thus a department may be recognised for the Intermediate Examination, which means that if a student passes the college's own examination at the end of the normal period (say three years), he will be exempted from taking the professional institution's own examination. Similarly, but with more rigid safeguards, the college's own final examinations may be recognised as exempting from the final professional examination. The college or department is thus said to be fully recognised by the professional institution. In these circumstances the college usually has much more latitude and scope in the choice and treatment of the syllabus and the whole becomes a reasonable partnership, subject to proper safeguards, such as periodic inspection and the appointment of external examiners). The partnership may work so well that the professional institution may discontinue its own examinations and require those wishing to enter the profession to study at one of a limited number of recognised colleges, as with architecture. In other cases, as in chemistry, the recognised colleges' internal examinations year by year are accepted and the head of department has to certify that the student is properly prepared and ready to take the final examination, which is wholly conducted by the Royal Institute of Chemistry itself.

The third way in which the professional institutions co-operate is in the recognition of certain examinations as exempting from parts of their professional examinations. This is most notably in their recognition of the National Certificate and Diploma examinations held under schemes sponsored jointly by the Ministry of Education and themselves, and of similar examinations conducted by the regional examining unions.

The Regional Examining Unions and the City and Guilds of London Institute have also had a profound effect through their syllabuses and examinations upon the development of technical education, and not least because of the true partnership exhibited in the work of the almost innumerable Advisory and Subject Committees wherein most of the educational work is done. Again there is another diverse group of societies and bodies conducting examinations and, of these, the long-established Royal Society of Arts is a leading example. The list of such bodies concerned with technical college courses, and who may seek co-operation through nominated representatives is very long (Appendix, p. 616), and reference must therefore be made to their prospectuses for full details of their syllabuses and examinations.

Throughout most of the foregoing, the Ministry of Education brings its influence to bear through the H.M.Is. or its officials acting as assessors, to secure the desirable standardisation of schemes (but not rigidly so) and in the spreading of ideas often from apparently unrelated schemes.

One other important group remains in the universities: their relationships with technical colleges are very varied, but the London University External Degree System is of dominant importance. The degree of partnership in this system and in the work of the foregoing examining bodies and professional institutions, from full co-operation down to arrangements for 'work—without representation' will now be considered in more detail.

Regional Examining Unions

Whether they be old or comparatively new the unions have all had two main aims: 'The object of providing standard examinations for the benefit of students attending classes in technical and other subjects recognised by the Union' within the Institutions of its area and 'otherwise to promote the objects of such institutions'. In fulfilling these aims the four Unions have profoundly affected the growth of technical education, and seldom can the original aims of founders have been so abundantly fulfilled beyond all expectation.

The oldest Union, and the only one stemming directly from the Mechanics Institutes, is the Union of Lancashire and Cheshire Institutes (U.L.C.I.) which was founded in 1839 and first began examining in 1847. This remarkable persistence through all vicissitudes is emphasised by reading the histories of other areas, and especially that of the Northern Counties Technical Examinations Council (N.C.T.E.C.) in the account *Almost an Ancestor* [12]. From the days of the Mechanics Institutes [13] to the present work of the U.L.C.I., with the record number of 50,674 students, is a far cry indeed [14]. In addition to conducting examinations in institutions in Lancashire and Cheshire and the county boroughs therein, the U.L.C.I. has recently extended its work to Caernarvonshire, Denbighshire, Flintshire and the Isle of Man.

The Union of Educational Institutions (U.E.I.) was formed in 1895, began examinations in 1896, and now conducts them in an area ranging from Cornwall and Devon in the west to Huntingdonshire in the east, from Hampshire in the south to Staffordshire in the midlands [15]. Fifteen county boroughs, the State of Jersey and some other areas come within its influence. In 1953 the total number of candidates was 13,491 [16].

The East Midland Educational Union (E.M.E.U.) was founded in 1911 and covers the geographical counties of Derby, Leicester, Lincoln, Northampton, Nottingham, Rutland and the Soke of Peterborough, including the county boroughs therein [17]. In contrast to that of the U.E.I. it is a compact area which enables constituent members to attend meetings without undue difficulty. In 1953 the total number of candidates was 23,377.

The Northern Counties Technical Examinations Council (N.C.T.E.C.) was founded in 1920, or, in a sense, was refounded then in succession to the Northern Union of Mechanics Institutes which was founded in 1848. In 1856 the Northern Union had elaborated a complete scheme of examinations but it was never used and, apparently without this cohesive influence in its work the Union never flourished and finally became a casualty of the first world war [12]. Examinations were first held in 1925 and in 1952 the number of candidates was 23,052 [18].

The Unions have many features in common. Whatever the names and place of origin they are now effective federations or partnerships of local education authorities and educational institutions. The latter include not only the colleges concerned but also representatives of the universities, and there are signs of an extension of membership to include other bodies. An example is the recent alteration of the constitution of the U.E.I. to provide an Associate Membership to cover, in the first instance, the representation and needs of certain training establishments of the Ministry of Supply. Each Union has a distinguished president, who may be elected annually, and give a presidential address at the annual general meeting: these addresses, and those of other eminent speakers, have made valuable contributions to the literature of technical education. Each Union is governed by a council representative of all interests, but it is in the Advisory Committees that the real work of a Union is done, as a result of a real partnership between teachers from the constituent institutions depending on the particular subject concerned, the H.M.Is., the Local Education Authorities' officers and the secretariat. Their work is primarily educational in the drafting of syllabuses and then, derivatively, in the assessing of examination papers. The examination scripts are marked by Examiners largely drawn from the teaching staff of the colleges and the results are moderated by an Examinations Committee. Table 21 shows the examination results for 1953.

TABLE 21

EXAMINATION RESULTS OF THE EXAMINING UNIONS, 1953

Union	No. of Exam. Scripts	% Pass	No. of Individual Candidates	% Pass
Union of Lancashire and Cheshire Institutes (U.L.C.I.)	144,776	67·4	38,180[a]	62·5
Union of Educational Institutes (U.E.I.)	50,978	72·0	(*b*)	(*b*)
East Midland Educational Union (E.M.E.U.)	30,279	74·0	11,720	70·0
Northern Counties Technical Examination Council (N.C.T.E.C.)	66,077	72·0	23,052	59·3

Note (*a*) These 38,180 took complete grouped course certificates; there were 12,494 other candidates who took one or more single subjects, or did not sit a complete grouped course examination.
(*b*) Figures not available in this form.

Initially the work of the Unions was with elementary subjects taken by part-time students, but it has undergone considerable change. The range of subjects has increased greatly and now includes technical, commercial and literary subjects. Moreover, as the needs of more and more industries were met, the standard has increased from the pre-senior stage until now the senior and advanced courses form an important part of the whole.

The examinations of the Unions are recognised at various stages by other bodies, e.g. by the City and Guilds of London Institute (p. 150) and by the Joint Committees governing the award of National Certificates (p. 154). Where available the latter results are shown in Table 22.

The National Certificates are a particular example of grouped course certificates. Over the years the number of students taking grouped courses have increased greatly, and the Northern Counties T.E.C. reported that in 1945 not more than one certificate in 200 was awarded for success in a single subject only [20].

TABLE 22

NATIONAL CERTIFICATES GAINED THROUGH THE REGIONAL EXAMINING UNIONS, 1953

Union	Ordinary Certificate (O.N.C.)	Higher Certificate (H.N.C.)
Union of Lancashire and Cheshire Institutes (U.L.C.I.)	1,350	390
Union of Educational Institutes (U.E.I.)	154	3
East Midlands Education Union (E.M.E.U.)	233	48
Northern Counties Technical Examinations Council (N.C.T.E.C.)	530	Nil
TOTAL	2,267	441
GRAND TOTAL AWARDED NATIONALLY [19]	11,785	6,659

The arrangements for examinations have changed over the years to meet changing needs, most notably in the separation of examinations for evening courses held at the end of the spring term, from those for part-time day courses usually held in June. Furthermore they have been extended to cover full-time pupils as in the U.E.I. Assessment Scheme for internal examinations conducted in secondary technical and secondary commercial schools. This development is likely to be greatly exceeded by others on a much greater scale for technical subjects in all secondary schools.

The first is the association of the U.L.C.I. with the Northern Universities Joint Matriculation Board in setting up a Joint Standing Committee in 1951, charged with the responsibility of advising the Board in all matters relating to examinations for the General Certificate of Education for students in the field of technical and commercial education [21]. The second is the establishment in 1953 of the Associated Examining Board for the General Certificate of Education, formerly projected as the Ninth Examining Body. Strictly speaking their province is secondary education, but many technical college students, full-time and part-time, will take these examinations. The value of these new examinations will depend in some degree, if not greatly, on their acceptability to the universities and the professional institutions, and this at a time when there is an increasing emphasis on continued general education [22].

The Standing Conference of the Regional Examining Unions enables them to consider matters of common interest such as examiners' fees, relationships with other bodies and, for example, the recent setting up of the Associated Examining Board already referred to.

In 1933 an agreement was made between the Board of Education, the City and Guilds of London Institute and the four Regional Examining Unions on the conditions governing the establishment in England and Wales of the intermediate examinations of the Institute. This was 'the provision that the Institute will accept from Authorities who are members of Examining Unions candidates for certain Intermediate Examinations of the Institute only on a request from the Chief Education Officer in specific terms'. Competition was thus avoided and the 'concordat' led to increasing co-operation, but since the war rapidly changing conditions have raised new problems of interpretation and application. These are under discussion, and the Standing Conference has marked its appreciation of its special relation to the Institute by inviting the latter to be represented at all its future meetings.

Thus through the conference the benefits of partnership are more widely spread while regional interests are safeguarded. The Unions generally are far older and more clearly defined and circumscribed in purpose than the regional advisory councils and thus their proven work is far greater and their future far more assured than that of the advisory councils. The only conceivable defect in both bodies is the potential restriction of the academic standing and autonomy of the regional institutions. That apart, we may expect them to flourish to the general good with the continued growth of technical education.

The City and Guilds of London Institute

A meeting of representatives of the Livery Companies of London at the Mansion House on 3rd July, 1876, adopted the following resolution:

> 'That it is desirable that the attention of the Livery Companies be directed to the promotion of education not only in the Metropolis but throughout the country and especially to technical education, with the view of educating young artizans and others in the scientific and artistic branches of their trades.'

The resulting provisional committee formed in 1877 led to the foundation of the City and Guilds of London Institute for the Advancement of Technical Education which was incorporated in 1880 with Mr. (later Sir) Philip Magnus as Director and Secretary (in whose honour and name the important series of Memorial Lectures are held by the College of Preceptors). Since that date the work of the Institute, as now organised in the Department of Technology, has grown immensely in volume, range of provision and in standard of examinations, as shown in Diagram 16.

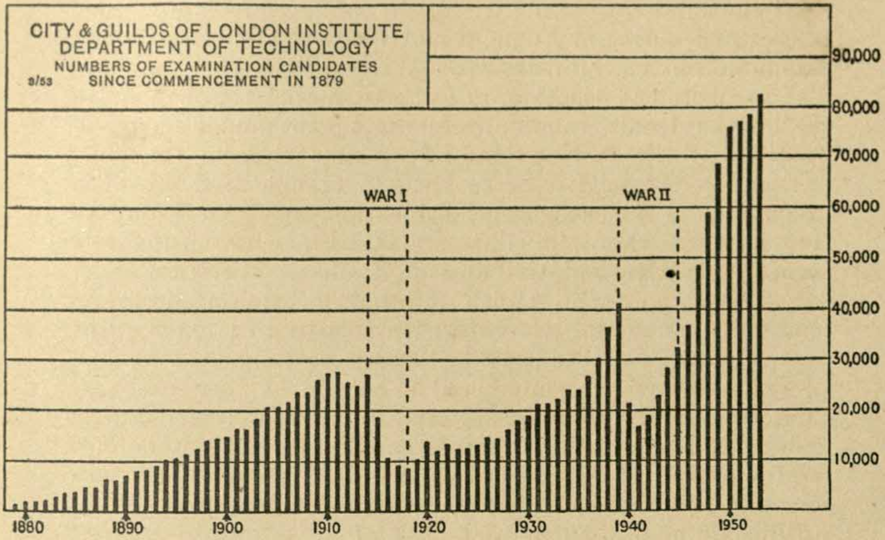

DIAGRAM 16

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In 1953 the total number of candidates was 82,287, a marked and rather unexpected rise from 77,951 in 1952. This and the general expansion is due in part to continual addition of new subjects, and the number of examination papers set was 806 in 1953 compared with 770 in 1952. The examinations are taken by many in H.M. Forces, ships of the Royal Navy and Merchant Navy at sea and in places as isolated and distant as Ascension Island, the Seychelles, Concepcion (Chile) and Fiji [23].

Where the need for examinations in a new subject becomes evident, the Institute sets up an Exploratory Committee representative of the various interests concerned—industry, the technical colleges, government and professional institutions, and at this very early stage the essential partnership is established which is the basis of all future development of the new line in particular and of the Institute's work in general. If it is justified the Exploratory Committee is succeeded by a fully constituted permanent Advisory Committee which drafts the syllabuses and regulations for the Course. Such new courses may be other than craft work and, although it would not be proper to offer them as National Certificate courses, they can be valuable developments, e.g. illuminating engineering, plastics, petroleum products.

The ultimate responsibility for the conduct of examinations is that of the Examinations Board which has representatives nominated by the Ministry of Education, the Scottish Education Department, the County Councils Association, the Association of Education Committees, the Association of Technical Institutions, the Association of Principals of Technical Institutions, the Association of Teachers in Technical Institutions, the National Society of Art Education, the Association of Teachers of Domestic Subjects, the National Union of Teachers, a representative of each of the Regional Examining Unions and the Welsh Joint Education Committee. The Constitution has recently been revised to include three representatives of the Regional Advisory Councils and one of the Association of Municipal Corporations. The work of moderating examinations is undertaken in over 90 Moderating Sub-committees of the Examinations Board.

High standards of performance in the examinations are encouraged by the award of medals and prizes to outstanding candidates, and in 1953 four Gold Medals, 193 Silver Medals, 167 Bronze Medals and fourteen other trophies were awarded, and also money prizes to the value of about £1,242.

Of the multiplicity of the Institute's work, three important new developments must be mentioned. The first is the Insignia Award in Technology (C.G.I.A.) which was established in November, 1952:

> . . . to provide a high qualification for persons in industry whose early training in industry was based upon practical experience combined with theoretical study and who had gained appropriate City and Guilds Certificates as craftsmen or technicians. Candidates are considered in terms of five broad industrial groups, namely chemical industries, constructional industries, electrical industries, mechanical industries and textile industries.

After inspection of their applications by an authoritative Insignia Awards Committee suitable candidates are accepted for registration and are then allotted topics for thesis, which is certainly required to be far more than a mere report of experience [24]. The second is the provision of a Technical Teachers' Certificate, as a result of taking approved part-time courses (p. 538). Reference has already been made to the third development (p. 99), namely, the Associated Examinations Board, for the administrative work of which the Institute is responsible.

The examinations of the Institute are the recognised premier craft examinations nationally, but latterly increasing concern has been expressed at the unwarrantably high requirements in theory of certain examinations, as with the Final Examinations for Machine Shop Engineering, Fabrication of Steelwork Design, and Electrical Installation. Concern has also been expressed at the highly verbal nature of theoretical examinations in essentially practical crafts. If these trends persisted great harm would be done to the general applicability of the examinations for practical crafts. As a contrary trend, however, the Institute has recently agreed to severing its connection with the Higher National Certificates in Textiles on which self-same examinations, anomalously, both the Higher National Certificate and the City and Guilds of London Final Certificate could be gained simultaneously.

The Royal Society of Arts

Founded in March, 1754, the Society has recently celebrated its bicentenary after a fascinating career through many vicissitudes to the then unimaginable world of to-day [25]. Its full title, still as originally given by William Shipley, is 'The Society for the Encouragement of Arts, Manufactures and Commerce'. From this it will be apparent that it has dealt with much that is germane to technical education, as shown in the recent History, especially its Chapter XV on the Society's examinations.

Of all the ideas and activities first introduced or sponsored by the Society only

> . . . its examinations organisation has grown to maturity under the parental roof, and still remains very much a member of the family although it has now set up house on its own. Indeed there are probably many thousands of people who know little of the Society except as an examining body and to them it stands as the oldest and largest examining body of commercial subjects in the country [26].

The examinations were started soon after the 1851 Great Exhibition, but the present series of commercial examinations did not begin until 1882. From about 9,000 candidates and 10,000 worked papers in 1900 the number has increased extraordinarily to the 1953–54 total of 155,341 entries and 147,254 worked papers. Of these the ordinary (single subject) series accounted for 127,107 entries and 120,938 worked papers, which include eight foreign languages, Esperanto and English [27]. Besides these are the examinations for the Teachers' Certificate in shorthand and typewriting, the proficiency tests in shorthand and typewriting for the Civil Service and British

European Airways respectively; preliminary examinations are held for the Railway Executive of candidates for British Railways Traffic Apprenticeships, and there are two schemes of examinations for the Diploma in Road Transport for administrative and operative staffs of road transport undertakings.

As with other examining bodies the Society has found it most beneficial to have various series of prizes for candidates, and the Silver Medals and Associateship are highly prized awards. The latter may also be awarded on the results of competitions, for example the notable Industrial Art Bursaries Competition with awards of travelling scholarships which are of inestimable value to students at a formative stage of their careers. Like other examining bodies, the R.S.A. has found a partnership in committees, with teachers and representatives of many bodies connected with education indispensable both to the maintenance and development of its work.

Joint Committees for the Award of National Diplomas and Certificates

Valuable though the early work of the various examining bodies was in providing an incentive to continued study in elementary and craft subjects, there was until 1921 no comparable incentive in the higher, more professional grades of part-time education. In that year the Board of Education discussed with the Institution of Mechanical Engineers the possibility of a higher qualification approaching the standard of a degree for engineers through part-time study. Two points of importance (Chapter XV) should be noted; first that the standard of degrees was much lower than now, but so also was the entry standard to such courses; and secondly that it is quite incorrect to project back into those days present-day distinctions between technicians and technologists. What was sought was a higher qualification for *engineers* working in industry and undertaking part-time study. The aim was also to meet the need of teachers in technical institutes for a system of examination which would permit reasonable freedom and flexibility in teaching method [28].

1921 is thus a notable date in the history and development of technical education for then the National Certificate Scheme was launched first in mechanical engineering, and then in chemistry in conjunction with the Institute of Chemistry [29]. So well founded was it that this initial scheme has remained the essential model for all future ventures listed in Table 23 [30, 31], and shown in Diagrams 26, 27, 29. The Scheme was also extended to cover full-time Diploma Courses but as will be seen from Table 24 these have developed hardly at all in comparison with the part-time Certificate Courses [32].

TABLE 23

ORDINARY AND HIGHER NATIONAL CERTIFICATES (PART-TIME COURSES) 1952–3*

Date Established	Subject	Ordinary (O.N.C.)				Higher (H.N.C.)			
		Entries		Successful Candidates		Entries		Successful Candidates	
		1952	1953	1952	1953	1952	1953	1952	1953
1943	Civil Engineering	—	—	—	—	119	188	96	162
1921	Mechanical Engineering	11,803	11,777	5,872	5,457	4,018	4,119	2,712	2,773
1923	Electrical Engineering	5,698	5,429	3,087	2,791	2,529	2,679	1,810	1,848
1941	Production Engineering	—	—	—	—	413	402	354	321
1929	Building	1,661	1,726	1,087	1,137	795	848	667	689
1921	Chemistry	1,285	1,494	729	917	593	687	364	448
1947	Applied Chemistry	51	30	34	19	37	40	31	26
1945	Metallurgy	334	390	186	184	132	140	120	116
1945	Applied Physics	131	151	64	64	30	55	20	27
1939	Commerce	321	412	183	255	11	6	8	5
1926	Naval Architecture	89	89	53	49	49	45	44	42
1934	Textiles	252	235	189	188	105	121	85	107
1952	Mining	352	510	190	280	—	—	—	—
	TOTAL	21,977	22,243	11,674	11,785	8,831	9,330	6,311	6,659
	Percentage Pass	—	—	53·1	53·0	—	—	71·3	71·4

TABLE 24

ORDINARY AND HIGHER NATIONAL DIPLOMAS (FULL-TIME COURSES) 1952–3†

Date Established	Subject	Ordinary (O.N.D.)				Higher (H.N.D.)			
		Entries		Successful Candidates		Entries		Successful Candidates	
		1952	1953	1952	1953	1952	1953	1952	1953
1921	Mechanical Engineering	159	144	88	72	124	147	83	114
1929	Building	193	140	125	108	113	120	94	100
1923	Electrical Engineering	58	73	40	34	82	118	73	98
	TOTAL	410	357	253	214	319	385	250	312
	Percentage Pass	—	—	61·7	60·0	—	—	78·3	81·0

These schemes can best be studied in detail in the rules governing the arrangements and conditions for the award of National Certificates/Diplomas published by the Ministry of Education (Appendix, p. 621), the various publications of the professional institutions concerned, and the way these are embodied in the prospectuses of the various colleges concerned.

The Joint Committees have been a partnership of the Ministry of Education for England and Wales, the Scottish Education Department for Scotland and the Ministry of Education for Northern Ireland respectively, and the professional institution(s) concerned, but this basis has been widened in some cases. A few examples are given in Table 25 overleaf [30].

Though the joint committees are thus representative of two main interests, the carrying out of these National Schemes is in fact tripartite with the technical colleges as the third and far from sleeping partner. In fact the schemes would be paper aspirations only were it not for the work of the colleges, and

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* Total O.N.C. 1954=12,443, 1955=13,922. H.N.C. 1954=6,950, 1955=7,507.

† Total O.N.D. 1954=361, 1955=412. H.N.D. 1954=248, 1955=338.

TABLE 25

CONSTITUTION OF SOME NATIONAL CERTIFICATE/DIPLOMA JOINT COMMITTEES

Subject	*Representatives of Ministry of Education and of the following Professional Institution(s)/Other Bodies*
Mechanical Engineering	The Institution of Mechanical Engineers
Production Engineers	The Institution of Mechanical Engineers The Institution of Production Engineers
Chemistry	The Royal Institute of Chemistry
Metallurgy	The Iron and Steel Institute The Institution of Mining and Metallurgy The Institute of Metals
Building	The National Joint Council for the Building Industry The Institution of Civil Engineers The Institution of Structural Engineers The Royal Institute of British Architects The Royal Institution of Chartered Surveyors

it is pleasing to record that their essential part is at last being recognised by including representatives of the technical colleges on the joint committee. This has recently been done for the long established Chemistry and Applied Chemistry Joint Committee and in the more recently established Joint Committees for Commerce, Retail Distribution and Chemical Engineering. These representatives are nominated by the appropriate Associations representative of technical education, e.g. one member of the Chemistry Joint Committee is nominated by the Association of Technical Institutions and one jointly by the Association of Principals of Technical Institutions and the Association of Teachers in Technical Institutions (Appendix, p. 621). This representation of technical colleges on joint committees is important in the context of the discussions on higher technological education and the status of technical colleges (Chapters XV, XVI).

In response to local industrial needs, whether anticipated or already urgent, the principal and head of department of the college discuss the possible establishment of a National Certificate/Diploma Course with H.M. Inspector. On a satisfactory outcome to these discussions the governors of the college make application through the Ministry of Education to the appropriate Joint Committee for the approval of the proposed scheme. Encouragement to go ahead may then be forthcoming but no official approval is given until the last year of the course is established. The proposed scheme must accord with the official rules (Appendix, p. 621) in matters of age and educational standards of entry, exemptions from these entry conditions, timetables, choice and sequence of subjects, staffing and equipment, and arrangements for examinations.

Assuming an approved scheme we can for simplicity discuss the courses in terms of Diagram 17.

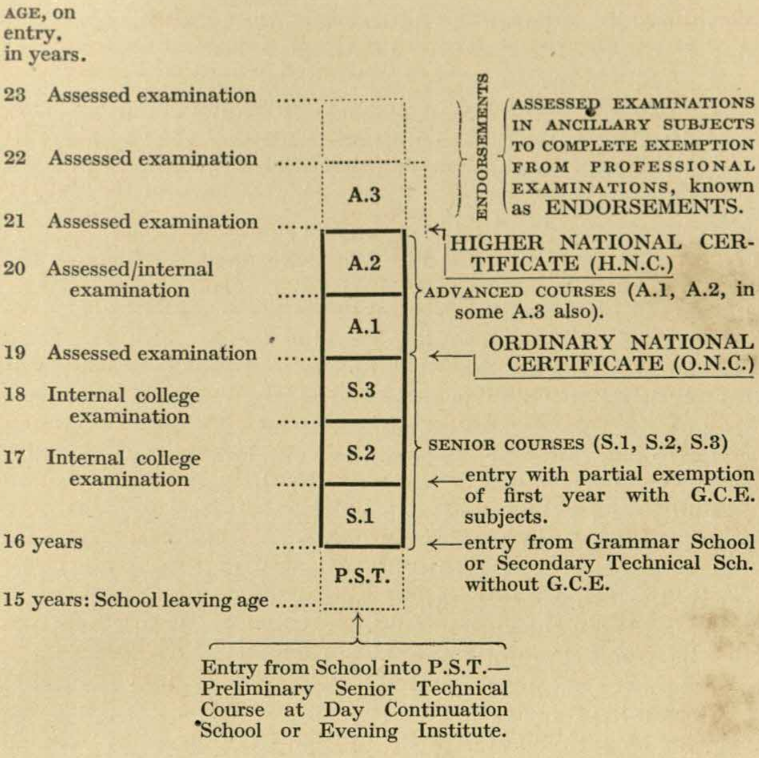
AGE, on entry, in years.
23 Assessed examination
22 Assessed examination
21 Assessed examination
20 Assessed/internal examination
19 Assessed examination
18 Internal college examination
17 Internal college examination
16 years
15 years: School leaving age
A.3
A.2
A.1
S.3
S.2
S.1
P.S.T.
ENDORSEMENTS
ASSESSED EXAMINATIONS IN ANCILLARY SUBJECTS TO COMPLETE EXEMPTION FROM PROFESSIONAL EXAMINATIONS, known as ENDORSEMENTS.
HIGHER NATIONAL CERTIFICATE (H.N.C.)
ADVANCED COURSES (A.1, A.2, in some A.3 also).
ORDINARY NATIONAL CERTIFICATE (O.N.C.)
SENIOR COURSES (S.1, S.2, S.3)
entry with partial exemption of first year with G.C.E. subjects.
entry from Grammar School or Secondary Technical Sch. without G.C.E.
Entry from School into P.S.T.—Preliminary Senior Technical Course at Day Continuation School or Evening Institute.

DIAGRAM 17. ARRANGEMENTS FOR A COURSE FOR ORDINARY AND HIGHER NATIONAL CERTIFICATES

In many schemes if a student passes at the appropriate level in his Higher National Certificate examinations he becomes eligible for exemption from related parts of the examinations of the professional institution, and he may complete exemption from the remainder by taking additional subjects which are 'endorsed' on his Higher National Certificate. These he may take according to his ability or the time available in the A.3 or subsequent year. After he has completed his examination and thus acquired the status of a graduate member of the institution, e.g. G.I.Mech.E., he is required to spend a number of years in the practice of his profession, and to gain a position of sufficient responsibility before he becomes eligible for the Associate Membership of the Institution, e.g. A.M.I.Mech.E. and A.M.I.E.E. After many years of industrial/professional experience with the attainment of high responsibility he may be elected to 'full membership' of the professional institution, e.g. M.I.Mech.E., and M.I.E.E.

Though the way is long, National Certificates nevertheless have provided a valuable route to professional status alternative to that through the university degree plus equivalent industrial experience, which explains their profound influence on the growth of technical education, especially when the schemes were able to expand their content in day-release courses. This in turn led to increasing requirements from the professional institutions by way of total hours of study, numbers of 'assessed' papers and standards of passing (e.g. at credit level). This ever-rising spiral is now acquiring an even steeper gradient, so that it is becoming increasingly difficult for students to reach professional status through this part-time route.

There is a difference between the conduct of the examinations at various stages. At the end of the first year (S.1) and second year (S.2) of the Ordinary National Certificate Course college examinations are held, which are set and marked by the college staff. At S.3 the examination is subject to assessment, the procedure being as follows. The college staff set draft papers in the various subjects, which are then submitted to the Joint Committee, which refers them to appointed assessors (or examiners). Each assessor examines the paper to determine its coverage of the subject and its standard in relation to national standards through the colleges as a whole. If it is satisfactory, he will return it unaltered; otherwise he will suggest or make certain alterations in accordance with rules laid down by the joint committee. Thus, he may substitute up to 40% of the questions, and may make up to 40% of the questions compulsory.

The draft paper thus becomes an assessed paper of a standard acceptable to the Joint Committee. The students then sit the examination, and their scripts are marked by the college staff. Finally the marked scripts and results are submitted to the assessor and may be altered in the determination of a national standard. The National Certificate is awarded upon marks which are a composite of homework, classwork and laboratory work and the assessed examination marks, provided 60% attendance and certain other requirements are met. Homework and classwork marks and examination marks must each reach 40% of the possible; the examination marks are weighted in the final assessment to form 70% of the total marks, of which the student must gain at least 50%. The Higher National Certificate is awarded on a similar basis of assessed examinations at A.2 and total records. College internal examinations only are required at A.1 but the papers may be assessed in order to rank for exemption from professional examinations.

This system has served the students well—and the professional institutions also—but the present very large numbers especially in engineering were hardly envisaged when the schemes were started. Delay in obtaining the final assessed results is inevitable with such large numbers and much thought has been given to reducing it to the very minimum. Technical college students sit many examinations which are set and marked by a body entirely external to the college, and in the content and conduct of which the college staff have no say whatever. Such 'external' examinations rigidly treat all courses and students alike, with many attendant defects, notably the rigid specification of the content of courses in the light of past examination papers—a kind of retrospective education by case-law ill-suited to developing sciences and technologies. The National Certificate system, with its syllabuses and examination papers drafted in the individual college yet conforming broadly to a natural pattern, was an attempt to combine some academic independence with the rigorous standards of external examinations. Quite early in the development of these schemes, some colleges relinquished this academic independence to the Regional Examining Unions by accepting the latter's syllabuses and examinations instead of devising their own. One argument was the need for standardisation to enable students to move from one area/college/course to another without difficulty; another was that for the Ordinary National Certificate at any rate, real differentiation on a local basis was not feasible during what should be fundamental subjects at this level [33].

Though Diagram 17 gives the general pattern, there are many significant differences. The Higher National Certificate in civil engineering is a three-year course (A.1; A.2; A.3, including endorsements) from Ordinary National Certificate (in mechanical engineering, electrical engineering or building) and there is no Ordinary National Certificate course in civil engineering. Similarly the Higher National Certificate in chemical engineering is a three-year course from Ordinary National Certificate in mechanical engineering, chemistry or applied chemistry. The Higher National Certificate course in commerce is three years following a two-year Ordinary National Certificate Course, thus inverting the usual three-year Ordinary National Certificate and two-year Higher National Certificate arrangement. Whereas the Higher National Certificates in civil, mechanical and electrical engineering give exemption from related professional examinations at present (pp. 255 *et seq.*), the Higher National Certificate in chemistry has not so far gained exemption from even part of the A.R.I.C. examination, though it is for an increasing number the penultimate qualification before the Associateship (p. 433).

The confusion is not lessened by the existence of other certificates called 'National', e.g. the National Craftsman Certificate for Vehicle Repair and Maintenance, which is not a National Certificate of the kind we have been considering (p. 278). Another example is the National Retail Distribution Certificate. In view of the foregoing examples we can only hope the foreigner will charitably conclude that our educational realism is in inverse ratio to our powers of logical thought, or at any rate of logical arrangement [34]. But within the broad essentials the pragmatic approach of those directly concerned has proved successful, mostly because there has been a real partnership in action.

One valuable feature is the recognition of specialised training by more than one professional institution, which is shown by the countersignature of National Certificates/Diplomas in respect of certain subjects, appropriate to the approved courses, as listed for example in Table 26 [30].

Universities and Technical Colleges

The relationships between universities and technical colleges are inextricably bound up with the whole problem of higher technological education and the policy implications are dealt with in Chapters XV and XVI. Here we simply note facts about existing arrangements [35].

The outstanding relationship is that with London University, especially through its External Degree system, seven colleges within the London area have recognised lecturers of the University and their students take Internal Degrees (Appendix, pp. 610–613). The remainder have no special recognition of teaching staff, and the students are registered with the External Registrar of the University and take the External Degree. The students may sit the examination in

TABLE 26

EXAMPLES OF COUNTERSIGNATURE OF NATIONAL CERTIFICATES

Course	*Specialised Subject*	*Countersignature*
Mechanical Engineering	Aeronautical Engineering	Royal Aeronautical Society
	Marine Engineering	Institute of Marine Engineers
	*Production Engineering	Institution of Production Engineers
	Foundry Work	Institute of British Foundrymen
	Chemical Engineering	Institution of Chemical Engineers
Civil Engineering	Structural Engineering	Institution of Structural Engineers
Chemistry and Applied Chemistry	Chemical Engineering	Institution of Chemical Engineers
Metallurgy	†Foundry Work	Institute of British Foundrymen

London or at a recognised provincial centre. Colleges wishing to submit candidates for the B.Sc.(Eng.) External Degree must first be inspected by the University, and 44 colleges have been recognised as a result [36] (Appendix, p. 610). The total of External Degrees gained in recent years are shown in Table 27 [37].

TABLE 27

LONDON UNIVERSITY EXTERNAL DEGREES GAINED BY TECHNICAL COLLEGE STUDENTS

Year	Applied Science	Pure Science	Commerce and Economics	Arts	Total
1951	504	571	109	27	1,211
1952	327	633	121	36	1,117
1953	336	598	136	32	1,102

To these should be added the 591 Internal first degrees obtained in the recognised colleges in 1953, making a total of 1,693. These first degrees in all subjects were obtained by students from over 90 different colleges, but in 1953 34 colleges produced almost 80% of the total. Only 14 colleges gained 25 or more degrees in 1953 (Chapter XV). Incidentally, technical college students gained a further 338 degrees through other universities, making a total of 2,031 university first degrees gained in 1952.

In recent years the University has been raising its standards considerably and the number of external candidates is likely to decline sharply. No one would wish to claim an inferior standard for external degrees so as to give the technical college student an easier passage, but all these changes are brought in very one-sidedly, with only a semblance of consultation by way of invited comments on paper, but never in person. The External Degree system is certainly a most unequal academic partnership; nevertheless many thousands of students have been able to gain graduate status and to proceed to higher studies and degrees and thus to have had pathways to promotion opened for them.

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* Ordinary National Certificate and Post Higher National Certificate only.

† Higher National Certificate in Metallurgy only.

The seven Polytechnics/Colleges specially recognised find the internal degree system to be generally, if not very, satisfactory. Altogether they had in 1953–4 some 70 recognised teachers who acted as members of the University Boards of Study and so took an active part in the revision of syllabuses, and in the setting and marking of examinations. There is close co-operation between the examiners and moderators and thus, in contrast to the External Degree system, there is a system of representation with sufficient flexibility to take account of particular requirements. On the board of examiners in any subject there is usually one representative from every college and institution presenting candidates. The examination papers, having been set by a sub-committee, are considered by the board, amended if necessary and finally approved.

Of the internal students in 1952–3 in the Faculty of Science of London University, 37·09% were in the Polytechnics and in engineering the proportion was 54·2%. Students of seven colleges secured 4 D.Sc., 93 Ph.D. and 88 M.Sc. degrees in the periods 1947–52. The close association with the University has encouraged better conditions of service and the appointment of highly qualified staff, and there are also definite athletic and social advantages to the students through the University of London Union, whether they are taking university courses or other approved professional courses not leading to university examinations.

A variety of other arrangements have arisen between some technical colleges and their neighbouring universities. The Imperial College of Science and Technology became a School of London University in 1908 and is counted a university institution, and certain departments of the Manchester College of Technology have since 1905 constituted the Faculty of Technology of the University (p. 60). Both these institutions have very recently received special government recognition and grant and are undergoing rapid expansion (Chapters XV and

XVI). Certain departments of the Belfast College of Technology also constitute the Faculty of Applied Science and Technology of The Queen's University, Belfast. Four other colleges are affiliated with neighbouring universities; the Royal Technical College, Glasgow, since 1912; the Technical College, Sunderland, with Durham University since 1930; the Heriot-Watt College, Edinburgh, since 1933; the Cardiff College of Technology and Commerce since 1937 [38]. The Bristol College of Technology was formerly the Faculty of Technology of Bristol University but the arrangement has recently been terminated (p. 497).

Other Non-Examining Partnerships

As a corrective to over-emphasising the importance of examinations we should now consider the invaluable contribution to technical education of many other bodies, both statutory and voluntary, which conduct no examinations but exert their influence in other ways, especially in the holding of conferences and the publication of papers on a wide variety of subjects of interest and usefulness to students and teaching staff, and to education and training staff in industry. It would be most unjust by this classification to imply that the work and influence of the professional institutions and other bodies such as the Royal Society of Arts was wholly or even predominantly through examinations. Such is far from the truth on the national basis, though it is predominantly so in their work in relation to the technical institutions. Nevertheless they, as well as the bodies we are now to consider, do exert a powerful educative influence in these ways, notably in the reading of papers, often original communications, at meetings of their branches as well as at the centre, and in the holding of conferences and social activities. For these and other reasons, teaching staff and students should join their professional institutions.

Association of Technical Institutions (A.T.I.)

The Association arose from a preliminary meeting held at the Manchester Municipal Technical School on 4th November, 1893 [39], and 17 establishments then mainly concerned with secondary education in technical subjects were represented at the meeting in 1893, and now in 1954 there are about 240 institutions in membership (pp. 10, 587). In the ironic flux of time, secondary technical schools are now excluded from membership. The Association is a thoroughly viable partnership of governor members and principals, who work harmoniously on the council and in the many sub-committees and joint committees with A.P.T.I. for the furtherance of technical education—harmoniously perhaps because salaries are never discussed! Not only does this fruitful interchange of ideas, criticism and comment take place in council and committee but also at the annual general meeting held usually towards the end of February in London, and at the summer meeting held usually in June or early July in different places in succeeding years. In February there is a Presidential Address and the Association has a long line of very distinguished Presidents who have made notable contributions in technical education in this respect as in other ways. At both meetings there is a variety of papers on technical education, and these are published to form a valuable part of the literature of technical education as is shown by the many references in this book [40]. Meetings of the branches are held from time to time when regional and local problems are discussed or matters raised for the attention of council.

The Association is governed by a council, composed of approximately equal numbers of governors and principals and of which the chairman is a governor or principal in alternate years. It is illustrative of our practical illogicality that governor members may include directors of education or chief education officers of the local authorities even though they are not elected representative governors of colleges. Some Authorities that ought to know better have latterly reduced their membership or, worse, have refused to pay travelling expenses to the meetings and one even refused leave of absence to the principal to attend. Having regard to the great benefits derived from governors, chief officers and principals working together on a national basis, this is surely a very short-sighted false economy.

Association of Principals of Technical Institutions (A.P.T.I.)

The A.T.I. sufficed for the needs of principals for many years, but altered conditions after the first world war led to the formation of the A.P.T.I. as the professional institution of principals [41]. The constitution was adopted at a meeting held at the Polytechnic, Regent Street, London, W.1, on 3rd March, 1921; in 1922 there were 70 members, and the number had risen to about 230 in 1953–4 (p. 10). Though its professional interests are its primary concern, shown for example in having two representatives on the Burnham Technical Committee (Chapter XVIII), it has never confined its interest to them or interpreted them narrowly. The partnership between principals is extended outwards in many ways in representation on many bodies (listed on pp. 616–620), and like the A.T.I., the Association is always ready to be consulted in the work and development of technical education, both at home and abroad. It holds its two main meetings on the day before the respective A.T.I. meetings and there are many branch meetings during the course of the year. Among the papers given by members at the main meetings in recent years may be cited the following; 'The Content of Education for Commerce'; 'Technics and Purpose—A Review of the Effect of Technology on Western Culture'; 'Planning and Equipping of New Buildings'; 'Liberal Studies in Technological Courses'; 'Courses in Retail Distribution'; 'The Organisation of Student Activities'; 'The Technique of Staff Selection'; 'Craft Certification'; 'National and Regional Organisation'; 'The Education and Training of Laboratory Technicians'; 'Professional Code for Principals'; 'Humanistic Aspects of Further Education'; 'The Relationship between Junior Technical Schools and Technical Colleges'; 'Non-teaching Staffs in Technical Colleges'.

Association of Teachers of Technical Institutions

The Association was formed on 22nd October, 1904, and assumed its present name in 1906. It includes within its membership all grades of teachers in technical colleges, assistants, lecturers and senior lecturers, heads of departments and some principals; and also head teachers and assistants in secondary technical schools. Part-time teachers who form such an important part of technical college staffing are also eligible for membership. In 1953–4 it had about 5,500 full-time and 500 part-time members paying subscriptions direct to the Association. About 70 principals are in membership.

It has six representatives on the Burnham Technical Committee (p. 616), and it is primarily a professional association concerned 'to promote and safeguard professional interests, for example in such matters as tenure, salaries, pensions, training qualifications, schemes of examination and inspection; and to lay the views of teachers in technical institutions before the educational authorities and the public.' Nevertheless it is also active professionally to advance the cause of technical education generally, and co-operates where desirable with other educational or scientific associations. Its affairs are conducted by a council representative of its 19 territorial Divisions. An annual conference is held at Whitsuntide, usually in a provincial industrial centre.

In accordance with a scheme of joint membership operative from 1st January, 1941, all members of the A.T.T.I. become members of the National Union of Teachers (N.U.T.) and all members of the N.U.T. in technical institutions become members of the A.T.T.I. The scheme is a move towards professional unity aimed to secure that, whilst the special claims of technical teachers should not be forgotten, the interests of the profession as a whole are advanced. In addition to the membership figures already given, a further 4,500 members pay subscriptions through the N.U.T. under this joint scheme.

The Association of Art Institutions (A.A.I.)

This Association is the analogue of the A.T.I. and was formed in 1943. Membership of A.T.I. has been open to the art schools and colleges but was never fully taken up for two main reasons. The first is the question of representation of schools of art which were departments of technical colleges; and secondly the real and imagined differences between technical education and art education, in outlook, courses and requirements. There is certainly much less congruity of interest between art and technical education than between commercial and technical education, but whether it is so much less or so negligible as to warrant a separate Association was and still is matter of debate. For all these reasons it has not been fully supported and its membership in 1952–3 was 76 institutions.

The National Society for Art Education (N.S.A.E.)

The Society dates back through the National Society of Art Masters (N.S.A.M.) to 1888, but the present title was assumed only in 1944 for, with the increase in the number of women art teachers, particularly in schools of general education, the term 'masters' in the Society's title had become a misnomer. The new title lays stress on the educational objective but the former professional objects are still secured by limiting membership to practising art teachers. Its membership is about 1,265 and is broadly classified into two categories; those engaged in schools of art (545), the other being specialised art teachers in all types of schools of general education and teacher training colleges (500). This is because of the different type of work which is called for in these different kinds of institutions and the classification is thus an educational not a professional one (p. 321). Like other professional associations, it has a branch/district structure and arranges meetings there as well as at the centre. It has provided regulations for the award of academic robes under certain conditions and grants Fellowship of the Society to distinguished members and Honorary Fellowship to other distinguished persons.

The National Association for the Advancement of Education for Commerce

This Association was founded in 1935 as the National Conference for Commercial Education by the Principals of Colleges of Commerce, mainly in London, with the active support of one of the publishing houses particularly interested in this form of education. In 1939 the title was changed to National Council on Commercial Education, and in 1945 to the present one. Its membership is about 400 and includes industrialists, education officers working in industry and professional organisations, principals and teachers of colleges of commerce and technical colleges and private business schools and interested publishers.

It is not a professional association and membership is open to all interested to support its objects. The Association provides a forum through an annual conference and branch meetings, for the discussion of questions of educational policy, schemes of work, syllabuses, curricula, teaching methods and examinations in education for commerce.

The British Association for Commercial and Industrial Education (B.A.C.I.E.)

Many people are still surprised that the roots of B.A.C.I.E. go back as long ago as 1919 under the name of the Association for Education in Industry and Commerce which had the main object of promoting the release of young workers under the 'Fisher' Education Act of 1918. In 1934 this Association and the British Association for Commercial Education were amalgamated to form B.A.C.I.E. as it is now almost universally known, with Lord Eustace Percy as its first President.

B.A.C.I.E. was, and still largely is, a voluntary association of companies contributing financially under covenants to the cost of its work. For that reason it might seem that its work ought to be considered in Chapter VI, but it is included here because it is exceptional among industry-sponsored organisations in the degree of partnership it affords to representatives of the technical institutions. This is seen not only in the numerous invitations to Conferences and Meetings, which provide an invaluable meeting place with leading representatives of industry, but also is secured in the constitution of its General Council.

Many activities are undertaken and valuable services are provided of which the following summary must suffice. An Information Department supplies information about what is being done in this country, the U.S.A. and other countries, to improve training and educational methods at all levels from apprenticeship and new entrants to higher management. A bi-monthly Journal, and a Members' Confidential Memorandum, issued alternately, disseminate useful information and advice on training and education. The Publications Department issues reports of conferences, reprints of addresses, manuals and booklets on a wide variety of topics.

A recent promising venture is the Communication Training Centre. This aims to improve training for clear and effective communication throughout industry and commerce covering the giving of orders, joint consultation, report writing, business letter writing, works information, committee work and reporting back. Realising that communication is more than the written word, important though that is, a special feature of the work is a series of courses in 'Running a Meeting', comprising instruction and experience in leading a discussion group, in conference method and acting as chairman or secretary of committees. Other special courses have been organised for industrial training and education officers and apprentice supervisors, covering such subjects as the psychology of learning and teaching, the use of visual and other aids, and human relations. A Visual Aids Committee has collected and disseminated much information in its field, and has produced two short training films with the assistance of some member firms. Six regional groups now exist which organise meetings, conferences, works and schools visits, study tours abroad and other activities which bring industry and education closer together. Annual conferences, usually at Ashorne Hill, near Leamington, are held for the discussion at national level of questions of education and training particularly relating to the improvement of productivity [42].

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CHAPTER VI

INDUSTRY AND EDUCATION

In this context industry includes the whole process from the raw materials to the final delivery of goods and services to the customer; it therefore includes design and production, distribution and sales, and related financial and business organisations. Though these all differ greatly in their educational requirements at different levels within themselves, in their own internal provision and in their need of the assistance of educational institutions, professional bodies and voluntary organisations, nevertheless their fundamental requirements are the same. In this context, too, education includes more than training, for education is concerned not only with the individual's livelihood, but with his or her whole life, with fostering personality as well as skills, with the growth of character as well as the increase of technical knowledge and competence. As distinct from education, by training is meant the instructional processes designed to develop skills and inculcate knowledge specifically required for particular processes. This is a useful workaday distinction though it cannot be rigidly maintained; for every training programme or course, however undertaken, has some effect on the individual's outlook and character, and is to that extent educational, and no education is wholly devoid of the acquirement of skills and knowledge (Chapter XVII).

Nevertheless we are here considering industry and education and not training, as would have been normal earlier this century. This would seem to put a preposterous strain on industry in this relationship or at least betray the wholly misguided view that industry is another group of educational institutions in disguise. The prime aim and end of industry is to buy, produce and sell, and to do it as efficiently as possible whether it is nationalised or not [1]. Nevertheless there is an obligation to provide education and training, which is inescapable in that it is essential both to the survival of the industry and of the nation. While it is vital to industry, training alone is not sufficient to meet present needs, for the technical problems are not the only or the most difficult ones. We are beginning to realise that we must take account of man's nature and that firms are in reality social organisations in which men and women must work together [2]. This realisation lies at the basis of the great development of management training and education since the war.

If justification were needed for thus linking industry and education together in the widest scope and closest embrace, there is ample support forthcoming from industry itself. The growth of training and education schemes within industry has resulted in an immense outpouring of literature designed to attract employees of ability. Most of it succeeds in being attractive and lively but not the least notable thing is the regularity with which such statements as the following appear, usually in the special introduction in its training brochure by the eminent chairman of the company.

> It should be appreciated from the very outset that a progressive Apprenticeship Scheme is as vital to the Company, and to the Engineering Industry as a whole, as it is to the individual. . . . Finally, it should be remembered that success in engineering or, indeed, in any other profession, demands something more than technical training. A wider culture is necessary to produce that understanding and breadth of vision which are essential to any man who must live and work amicably and efficiently with others [3]. Or again: In order to attain this objective (to ensure the continued prosperity of an organisation) . . . we have taken care to make sure that no boy who becomes one of our apprentices shall be denied the opportunity to make the very best of his talents and inclinations. His health and the development of his character are of direct concern to us and he will be able to take part in our many sporting and social activities [4].

The foregoing must serve as representative illustrations as it is quite impossible to quote any appreciable number of those who maintain these enlightened views [58]. Despite all the cynicism that such expressions of ideal policies may call forth in certain quarters, it is only just to record also that in most instances a very real attempt is made to live up to such ideals. Cynicism is but the insensitive apprehension of half-truths by a discouraged mind, and we need not fall into the error of supposing that because the prime purpose of industry is production its concern about its employees (at all levels) is nothing more than dubious exploitation. On the contrary, many firms have for many decades shown a lively human concern for their employees and an interest in education far beyond the needs and general practice of the times, and have shown the way to educational authorities and institutions on many occasions. Nothing can be more encouraging to those engaged in technical education than such enlightened leadership and that, in trying to share the benefits of technical education with the employees of less enlightened firms, they have such powerful allies *within* industry.

Such expressions of these ideals of technical education have not been confined to broad statements, and there has been a most lively interest shown by industrialists in the content and quality of education in recent years.

> Education has long passed from a luxury to a necessity. To-day more than ever before, it is of vital importance that the youth of Britain should be well educated. Unfortunately it is all too true that many of our young people get a college training without getting an education. Theoretical education, essential though it may be, is not in itself sufficient. There must be a proper balance of theory and practice. It is as necessary to know 'how' as to know 'why' [5].

Alongside this legitimate concern for combining theory and practical application we have an equal concern for other qualities than technical competence.

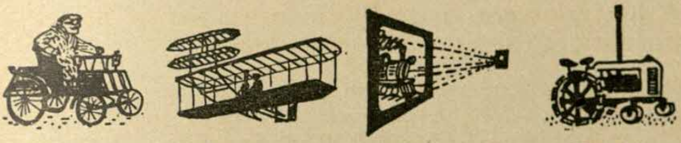
> The nation needs leaders who, whether scientists or not, have a clear idea of what science is about and can talk to scientists intelligently. Equally, it needs scientists who understand the political and social circumstances of to-day, and can express intelligent opinions about them. Such people exist but they are much too rare [6].

At the other end of the age scale there is the concern with education in the schools, not in any narrow specification for future occupational requirements, but quite the reverse.

> In our own trade school we have always insisted that the boys' technical training is combined with a continuation of general educational studies, on the principle that any school must accept its social responsibility involving preparation for life as well as training for a career. Painting in water colour is not incompatible with the precision required in the drawing office [7].

Once again such quotations, though authoritative, are but a minute fraction of the whole ferment of opinion expressed in the post-war years, and we may simply record a satisfaction at so lively and sympathetic an understanding of the aims of education. This is in marked contrast to the lack of status of technical education discussed in Chapter I, and we may therefore consider the reasons for these changing attitudes and the present emphasis on education and training.

The first is the far-reaching change in the nature of industry itself consequent upon the ever-accelerating tempo of scientific discoveries and their subsequent application. This plainly is true of the productive side of industry, but is also increasingly true of transport and communications which are as essential to the conduct of commerce as to the distribution of goods and services.

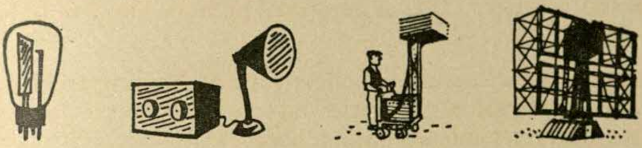


Motor car
from 1896, on
British roads

Aeroplane
1903, heavier than
air flight

Cinema
Public film
showings,
1895–1905

Tractor
Produced 1903. Into
use in 1920s

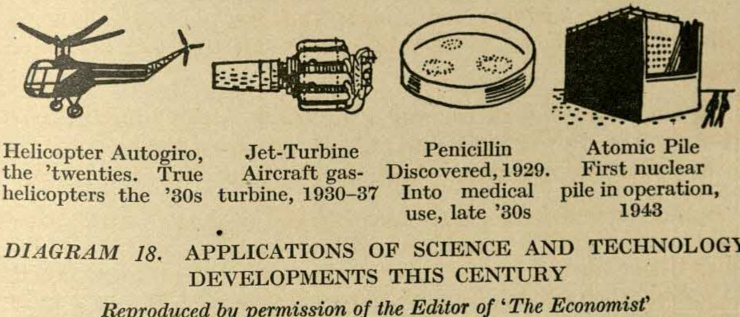


Thermionic Valve
1904–07, the key
to electronics

Radio Set
Broadcasting
began in the
'twenties

Fork Truck
Produced before
1914. Into use, the
1930s

Radar
Developed,
1935 and after



Helicopter Autogiro,
the 'twenties. True
helicopters the '30s

Jet-Turbine
Aircraft gas-
turbine, 1930–37

Penicillin
Discovered, 1929.
Into medical
use, late '30s

Atomic Pile
First nuclear
pile in operation,
1943

DIAGRAM 18. APPLICATIONS OF SCIENCE AND TECHNOLOGY DEVELOPMENTS THIS CENTURY

Reproduced by permission of the Editor of 'The Economist'

Now too these changes are spreading even into the routine side of business with the progress made in electronic calculating machines and other devices. (Indeed we stand on the threshold of an electronic age as much as of an atomic age.) But these changes are so subtly cumulative that it is only when we look back over the first half of this century that we realise how profound they have been. This was illustrated by the *Economist* by diagrams in its Coronation issue in June, 1953, under the title of 'The Promise of Technology' and one of these is reproduced in Diagram 18.

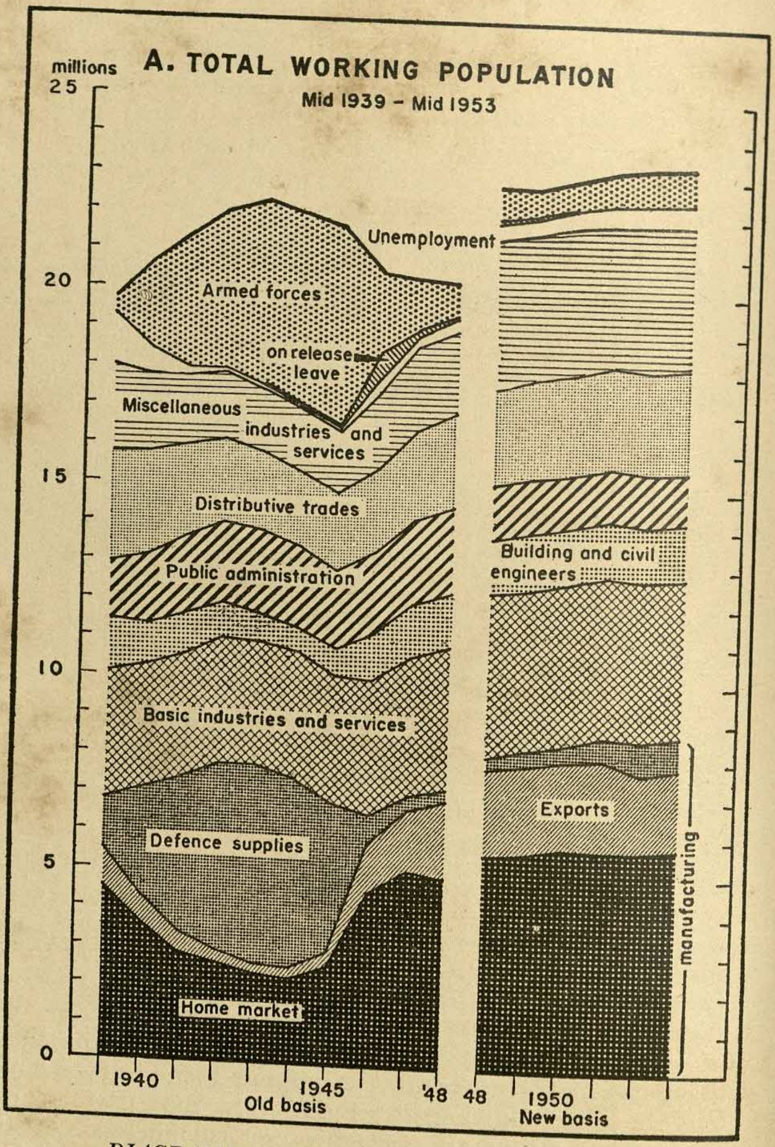


DIAGRAM 19A. CHANGES IN EMPLOYMENT
Diagrams 19A and B are reproduced by permission of the Editor, 'The Economist'

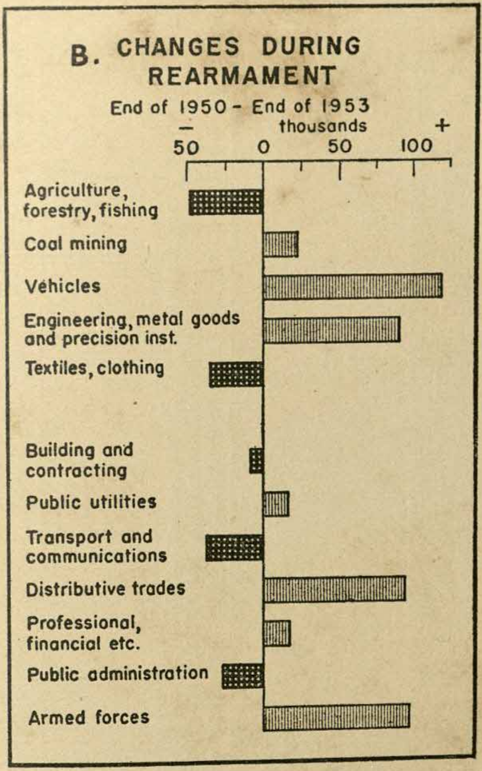


DIAGRAM 19B.

CHANGES IN EMPLOYMENT

Every one of the industries illustrated or implied in these diagrams needs a standard of education and training at all levels scarcely foreseen in 1900. None of the new modern products can be made without such education, nor can they be sold or serviced without it, least of all in the markets of the world at large. Though it is not a prime purpose, the changing character of industry has made education a prime necessity.

But the change in character is shown in other ways. The immense increase in the use of power, in the variety of materials and chemicals, has brought a new and vital emphasis on welfare and safety. These cannot possibly be secured without increased knowledge and awareness on the part of the individual and his intelligent and willing participation in guarding against the increased hazards of industry and daily life [8]. Another factor is the increased pace of development

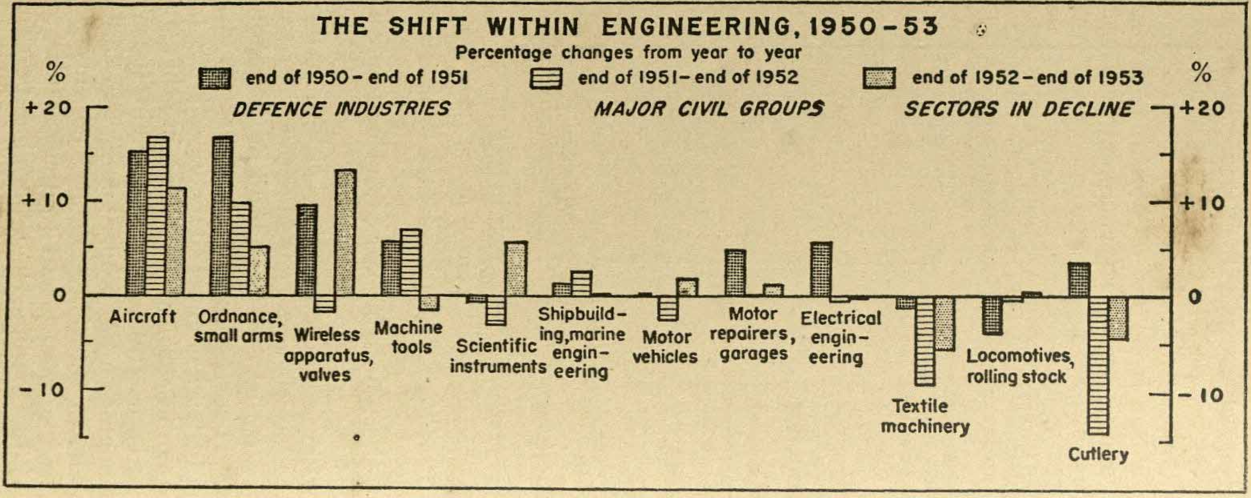
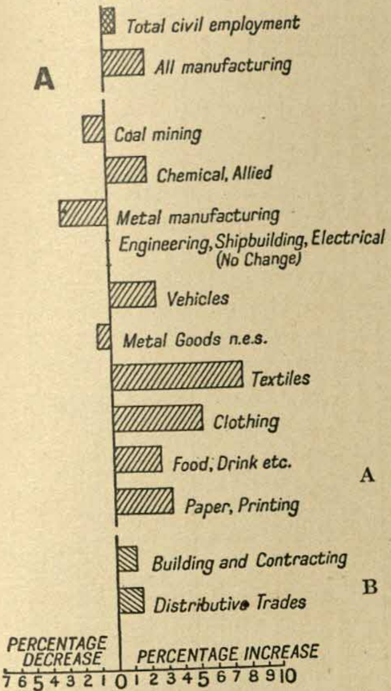


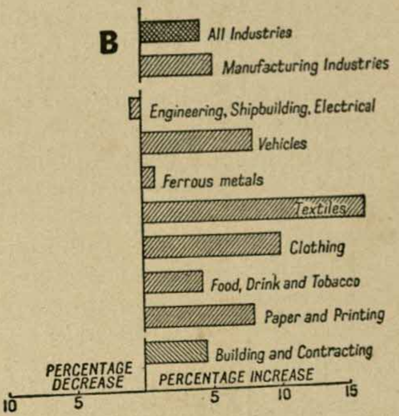
DIAGRAM 20

Reproduced by permission of the Editor of 'The Economist' in meeting new demands upon industry in a greatly disturbed or a sharply competitive period of world trade, when rapid changes are likely to take place within an industry or between several related industries. This is illustrated for the Total Working Population from mid-1939 to mid-1953 in Diagram 19A, and for changes during Rearmament from 1950 to 1953 in Diagram 19B [9].

CHANGES IN EMPLOYMENT, MAIN INDUSTRIES (End Oct., 1953, compared with end Oct., 1952, percentage change)



CHANGES IN INDUSTRIAL PRODUCTION, MAIN ITEMS (Percentage change; average index to latest date in 1953 compared with average index for year 1952)



A Numbers employed in selected industrial groups at end October, 1953, as a percentage of numbers employed end October, 1952. Calculated from Ministry of Labour figures on employment situation.

B All industries and total manufacturing, average index for ten months of 1953; other industries average for first three-quarters 1953. Percentage change compared with average index for 1952.

DIAGRAM 21. CHANGES IN EMPLOYMENT AND PRODUCTION
Reproduced by permission of the Editor, 'Times Review of Industry'

The shift in employment is shown for a single major industry in the same three-year period 1950–3 in Diagram 20 [9].

That the changes are marked within an even shorter period than three years is shown by Diagram 21A, of changes in employment in the main industries over a single year from October, 1952, to October, 1953, and Diagram 21B, of the Changes in Industrial Production, Main Items, during a similar period [10].

Such changes must be accepted as inherent in a technological society, and they put a premium on flexibility and adaptability both in the management and processes of industry and in the skills and outlook of the individual, not least in meeting the changing locations of industry. The education provided for those entering and working in industry should take full account of the need to promote flexibility and adaptability of skills and attitudes. Those concerned with education are not blameless in this respect, either as to content or to methods used, both within industry and in the educational institutions. Thus Sir Frederic Bartlett, Chairman of the Joint Committee on Individual Efficiency, holds 'that most of the training schemes are dominated by the ideas that the quicker the training is finished the better, and the trainee should be trained for one specific job only. Industry to-day is in a ferment of invention and a working population is needed that is alert, intelligent and adaptable. Instead training schemes are dominated by principles established long before present-day conditions were achieved' [11]. Such authoritative criticism, which is not isolated, should cause employers, trade unions and those in the colleges, alike to reconsider traditional ways of training, otherwise we shall not meet what the *Manchester Guardian Survey of Industry, Trade and Finance, 1954*, so rightly called 'The Challenge of Change'.

Such changes in traditional methods, and the introduction of thoroughgoing education schemes in the rest—and still the greater part—of industry will not come about without enlightened management and the wholehearted support of employees. Hence the urgency of management training and education, and the welcome increase in it since the war. The work of the schools is often done against the adverse influence of indifferent and sometimes hostile parents, and adult education is therefore a prime necessity for advance in the schools. In the same way, the progress of management education is a fundamental condition of the progress of education in and for industry. Management education is of course required for the better administration and efficiency of industry but even were it adequate to present requirements (which few would suppose), the signs are that more will be necessary in view of the growing size of firms.

The Acton Society Trust Report on *Size and Morale* [12], makes it very clear that a thorough investigation is needed into the problems of the relative benefits of centralisation and decentralisation, and especially with the hypothesis in mind 'That the urgency of and impact of certain social problems of industry vary significantly and directly with the size of industrial units. These problems—the maintenance of the sense of participation or belonging; of direct personal concern with the fortunes and performance of the enterprise—may be said collectively to constitute the problem of industrial morale.' The connection between morale and productivity needs no emphasis and the report does not suggest that the workers' morale must of necessity be worse in large than in small units [13]. Though this is a pilot survey of the problem in determining the significance of size of unit in influencing industrial morale and productivity, it is nevertheless clear enough that better management will be essential to solve the many problems indicated in the Report. If present trends persist or increase, the value of management selection and education will likewise increase still further over the next decade. This is supported by the general conclusions of the timely *Handbook on Education and Training for Management*, recently published by the Federation of British Industries [14].

The changing social pattern of the age has been increasingly democratic if not egalitarian, and with it has gone an increasing emphasis on more and more opportunities for higher education to enable each individual to realise his full potentialities. This has meant that an increasing proportion of good ability has gone on from school to the universities and major technical colleges instead of entering industry at an early age (Chapter VII), with a consequent re-entry of this ability into industry at a much later age. Unless training schemes were provided, the democratic feelings of those who had spent those years working in industry would have been offended. Moreover, due to other outlets and increased competition, the re-entry of ability did not equal the original intake and this made it more imperative to foster what was there already. The growth of full-time higher education has thus been accompanied by a great development in educational and training opportunities within the firms.

All these foregoing heightened requirements on the part of industry receive a sharper emphasis when viewed against the problem of recruiting ability in sufficient numbers in a world more avid of ability than ever before, just at the very time when the numbers of young people coming forward has declined almost catastrophically. For boys and girls reaching the age of 15 the numbers have dropped from about 740,000 pre-war to 571,000 at present. This situation will not be restored until 1963, and will decline again a few years thereafter. This is part of the changing age structure of our population which is shown in Diagram 22. The declining proportion of young people coming forward to support an increasingly aged population is clearly shown—a trend which is not likely to be soon reversed. The prospect is then of an increasingly static population (in numbers) with subsequent decline in total numbers and probably accompanied, unless we exert ourselves greatly, by many disadvantages, not least a declining standard of living consequent upon the slowing down of the rate of capital investment and of technical improvement [15].

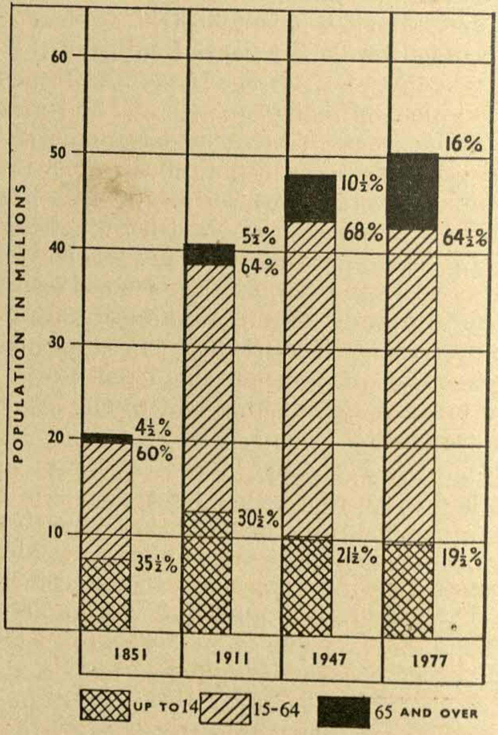


DIAGRAM 22.

CHANGING AGE-STRUCTURE OF THE POPULATION

Reproduced by permission of Professor S. Zuckermann and the Editor of the Unilever Journal, 'Progress'

The reader is referred elsewhere for authoritative studies and discussion of our manpower problems, their comparison with those of other countries, notably the United States, and their significance for education [16]. Here it suffices to note the conclusion that 'These reports and studies leave no doubt that, when every allowance has been made for the differences in background and way of life between the United States and Britain, the real hope of sustained improvement lies in the development and improvement of both general and technical education' [17].

Against this background of deficient provision somehow to be made good as soon as possible, there is one provoking question to be dealt with, if not to be answered. How much education must or need industry provide? Supposing defects in the educational system, arising mainly from understaffing in inadequate buildings, to be made good, what is the optimum provision of education on the part of industry? What are its determinants in levels of occupation, structure of industry, rate of development of new processes and so forth?

Education and research have developed greatly over the last few decades, and similar questions have been asked about the prosecution of reseach by industry. Both are creative activities though not in the same sense; the research is the creation of new processes, materials and services, education is the creation or fostering of qualities of mind and personality equal to the demands of creating and maintaining new processes, materials and services. Sir Harry Jephcott's comment on research is equally applicable to education and industry, as may be seen by reading 'education' for 'research' in the following context:

> How much to expend upon research is one of the most difficult decisions the industrialist has to make. It should be obvious that there can be no golden rule applicable to industry generally or even to all firms within a particular industry. Industry can only undertake research whose expenditure, it is judged, will be recouped in the short or long term and, if the expenditure is to be profitable, more than recouped by making available new or improved products for sale, or by making possible improved and therefore more economical processes [18].

These questions are bound to be raised when we review the present educational provision by and for industry, not because there is any real danger of exceeding the optimum provision (whatever that may be) but rather in the relative values of the many diverse arrangements now in use. There is need, therefore, for a detailed investigation of present facts in different industries and at different levels of the same industry before even tentative conclusions can be drawn, and the various optima estimated.

Another question to which no single answer can be given is where education and training for industry are to be provided

—within industry or outside? We leave till Chapter XV certain questions arising on higher technological education and its disposition between the universities and the technical colleges, and here consider what reasons should determine the provision by industry on its own or hired premises, or their arranging for other organisations to carry it out elsewhere. This again must necessarily be part of a larger survey than is possible in a single chapter, but certain things are fairly clear.

Specific training for a single job peculiar to the work and processes of the firm is usually regarded as the responsibility of the firm. Such induction training is rarely undertaken outside the firm, and it is hard to see how this could effectively be done away from actual work in progress. This does not include special rehabilitation training as undertaken by the Ministry of Labour Training Centres [19], nor yet the broader parts of induction schemes, though even these, if away from the works premises in more sylvan surroundings are largely given by senior staff of the firm. Much craft training and training for repetitive mass production processes come under this category.

By contrast, education and training which is of a much more general character, not specifically limited to a single machine or process, can and probably should be given outside the firm. This is compatible with mobility in the industry as a whole, as the underlying principles and practices are generally applicable in a wide variety of firms and maybe of whole industries. Nevertheless this more fundamental education gains greatly by reference to widely varying practice, and both students and staff profit greatly by having such diversity of experience and contact available within the same class. It is sometimes argued that attendance at a works school or course is more subject to the exigencies of the works than attendances at the local technical college when the student is beyond reach for the day. But in those firms where this situation is likely to arise, the student is not likely to arrive at college at all; conversely a firm large and enthusiastic enough to set up its own works school is likely to ensure that it is properly used. This argument can therefore only be sustained by the time-honoured method of comparing the best of one side with the worst of the other.

In some cases the clearest possible advantage lies with the firm, especially the very large firm, in providing appropriate practical experience for the student of a reality and in a way completely beyond the resources of any teaching institution;

costs of installation, maintenance and obsolescence almost wholly prevent the provision of large scale industrial equipment in college, and this despite the notable example of training on production established by Dr. Herbert Schofield at Loughborough College [20]. The Summer Schools arranged by Metropolitan Vickers Electrical Co., Ltd., are an excellent example of post-graduate refresher courses which are by their nature inevitably works-based. At a lower level, this constitutes the essential argument for sandwich courses and graduate and other apprenticeships.

The question of the desirability of where the education should be provided thus turns out to be one of feasibility and the solution can be varied with no set pattern. In contrast to the works-based training feasible with large firms, there are the externally based arrangements of the much more numerous smaller firms. Such firms have not the resources in manpower and facilities to meet the need for technical education though they give, with varying degrees of success, the necessary induction training. Many are quite unable to provide the full range of necessary craft training which must be secured mostly through the technical colleges, though the extent is largely determined by the structure of the industry. A very few examples exist of co-operation between groups of firms, but an interesting one is that of the Salford and District Textile Training Guild which arranges induction courses for juveniles entering the eleven firms in membership, at a place external to all the firms, and in co-operation with the Cotton Board and the technical college. These firms are quite separate and are not part of a combine, but have co-operated for the undoubted benefit of the employees and of the industry. While such experiments may increase, the technical college will probably always be the main meeting ground and means of education for the employees of the small firms.

Education and Training within Industry

Some or all of the following are undertaken by the medium sized or largest firms.

i. *Induction Courses.* These are a most important part of the education of the employees as they can greatly influence their attitude to their work and colleagues, with immense benefit to themselves and the firm (whose interests are not mutually exclusive). According to the nature of the work they may vary from one week to six weeks or even three months' duration. (Courses of longer duration are more aptly described as training courses.)

ii. *Works' Schools* are run by the firms on their own premises, with staff appointed by them from among or as their own employees. There is usually a full-time head of the school, assisted by other staff who may be full-time, or part-time members employed on production or elsewhere in the factory for the rest of the week. These arrangements are largely determined by the size of the firm, the nature of its work and the instruction to be given in the school. The younger employees attend for one-half day or a whole day per week. Some works' schools are inspected by the Ministry and are recognised as efficient (Appendix, p. 603); in other cases the school is staffed by teachers employed by the Local Education Authority, but the premises still belong to the firm. This transition in control which embodies an excellent example of co-operation is usually marked by the use of the different description as in iii.

iii. *Day Continuation Schools.* The 1918 Education Bill stated the need for 'continuing the education of young persons and helping them to prepare for the freedom and responsibilities of adult life', and this was recognised in the 1918 Act and again in the 1921 Education Act; provision was then made for the compulsory attendance of young people between 14–18 years of age in Day Continuation Schools for 320 hours a year, as from an appointed day. Only at Rugby was such a school fully established and continues to this day for young people up to 16 years of age [21]. Day continuation schools have been established in other areas with voluntary support but in most cases only where attendance is made compulsory by the firms employing the pupils. Day Continuation Schools are the forerunners of the County Colleges of the 1944 Education Act which, in some distinguished cases, are being voluntarily established in advance of an appointed date. The curricula of such schools is not restricted solely to vocational subjects.

iv. *Training Centres.* These are not linked solely or even primarily to the induction and training of juveniles but are organised for the reception, training and education of older employees. The work will probably comprise such courses as Training Within Industry (T.W.I.) for foremen and supervisors [22], and other and higher levels of staff and management training. If the firm is large enough the training centre may be dignified by the title 'Education Department' and include the works' school, arrangements for all apprenticeships (craft, trade and graduate), and for all induction courses, special post-graduate courses or schools; it will probably also arrange vacation experience for undergraduates and the visits of school parties, students from colleges and others round the works or business. There is the selection of recruits to the firm and placing them in the various departments, and the subsequent selection of employees to attend the wide variety of courses listed later under external arrangements. Another more recent duty, now increasingly realised, is that of holding special pre-service training courses of one to usually at most three days' duration [23]. These encourage a right attitude of mind to National Service and a readier return afterwards to the firm, which also helps by a kindly interest in their service and postings. Equally a welcome when on leave and on return are much appreciated. Other special courses may be held, for example, in accident prevention, work simplification, the introduction of new schedules, processes and materials. According to the size and organisation of the firm, to all this may be added other duties, as hard to list as they are difficult to limit—especially in consuming time; educational advice of a general kind and to employees' relatives; assistance with the activities of the Apprentices' Association; administration of a scheme of educational awards; preparation of material for special lectures; engaging outside lecturers. The question of suitable education staff and of a sympathetic management is thus very important.

The foregoing are means of providing education within individual firms rather than within and by industry as a whole. In the latter case the range of provision is different, being largely concerned with management training and education. The war accelerated the application of techniques of modern study to production problems; for example the Ministry of Aircraft Production arranged training courses in motion study demonstrating economies to be effected, and there were many practical examples at an impressive exhibition at the Carlton Hotel, London, in 1945. In the immediate post-war period there has been still further stimulus in the reports of the Anglo-American Productivity Teams [24], and in the establishment of the British Institute of Management (p. 211). As a result there has been an increasing number of courses and conferences, ranging from short courses of training in the techniques of work study applied to particular problems (e.g. plant maintenance), to broad studies of the human aspects of management, not excluding controversial economic, social and political issues. Another result has been the setting up of Local Productivity Committees.

Two trends in practical means of provision are clearly discernible. Some major firms and nationalised industries have acquired and adapted country mansions not merely for administrative convenience, but also to add the benefits of residential education in good surroundings to more formal lecture and conference room activities. In other cases there is co-operation between many firms in arranging such education and training. In the textile industry economic necessity produced a statutory instrument, the Cotton Board, which now arranges, with growing support from the industry, many conferences and courses to study the problems of the industry.

Roffey Park Institute is an example of a co-operative enterprise between 33 different industrial firms and commercial organisations and operates under its own Council without public funds. The Institute restricts its work to courses within the field of human relations, including human aspects of management and social medicine. Prominent among its activities are five-day courses in 'Human Relations in Industry and Commerce' and in 'Work Simplification' [25].

Another and outstanding example was the foundation in 1946 of the Administrative Staff College by a group of firms, both large and small, contributing income mainly under seven-year convenants. The college brings together men and women of ability and promise from industry, commerce, the trade unions and all forms of public service for a course of studies which investigates the principles and techniques of organisation and administration in civil life (p. 373). By giving the students a fresh awareness of the significance of their present work it prepares them for higher responsibilities in the future [26]. Arrangements may also be made through an employers' association, as in the Department of Work Study of the Engineering and Allied Employers' West of England Association, Brunel House, Bristol [27]. In other cases large firms may invite associated or customer firms to participate in training courses or in conferences, but few experiments have been made in this direction.

Another co-operative venture is the Industrial Welfare Society (Incorporated), founded in 1918, which now has subscribing members including 2,500 firms, public undertakings, local authorities and individuals [28]. These pay subscriptions according to the number of their employees, covering some eight million employees altogether. Over twenty week-end residential courses are arranged annually and many short courses are held on a half-day and one day basis. The residential courses have included all levels, e.g. foremen and forewomen, workers' representatives, shop stewards, canteen executives, office executives, directors, works managers, editors of employee magazines, and apprentices. There is an Information Service, Canteen Advisory Service, Films and Filmstrips Service, General Advisory Service, Journal and Handbooks. These are the instruments of inculcating 'the attitude of mind which the Society has helped to spread; that people matter and that man must be master of the instruments of science and production'. In furtherance of these aims there is to be held, in Oxford, in July, 1956, H.R.H. the Duke of Edinburgh's British Commonwealth and Empire Conference on 'The Human Problems of Industrial Communities within the Commonwealth and Empire'.

The Federation of British Industries through its Education Committee has become increasingly concerned with higher technological and management education. It has held an important series of conferences, of which reports have been published firstly on the universities and industry in 1949, then five regional conferences with the universities and, in 1954, one on Technical Colleges and Industry [29]. The Education Committee made the proposal which led to the publication of the Anglo-American Productivity Council Report on *Universities and Industry* (Chapter XV). Recently it set up a committee which has made striking recommendations on how to increase the supply of science teachers in the grammar schools, on which the supply of future scientists and technologists ultimately depends. The F.B.I. is represented on many educational bodies, including Regional Councils.

Though the responsibility for the foregoing examples of industrial education and training lies with the employers, both individually and collectively through their various representative organisations, it would be quite wrong to overlook or minimise the important influence of trades unions either through the Trades Union Congress (T.U.C.) or the local Trades Councils, or the representative workers on the shop floor (p. 375). Throughout its history the trade union movement has regarded education as a powerful means of increasing the effective strength of trade unionism, but no narrow conception of education as only specific training has been adhered to, and the educational activities have ranged from the directly vocational and utilitarian to the general background courses in adult education, management, social and political studies.

Part-time study is encouraged through the National Council of Labour Colleges (N.C.L.C.), and also through the Workers'

Educational Trade Union Committee which arranges an agreed educational programme through the Workers' Educational Association (W.E.A.) [58]. Full-time background study of one or two academic years may be taken at Ruskin College, Oxford, of one year at Coleg Harlech, Harlech, North Wales and Hillcroft College for Working Women, Surbiton, Surrey. For several years, courses in trade union subjects have been arranged in a few technical colleges on the initiative of certain unions. Recently more ambitious courses of three or four weeks' duration have been held in some dozen technical colleges, with a syllabus including Industrial and Social Factors in Industry, Payment Methods, Work Study, Factory Organisation and English Usage. Scholarships are offered by the T.U.C. for the many kinds of full-time study, and also for attendance at Summer Schools for trade unionists which are held abroad.

The General Council of the T.U.C. is represented on many educational bodies at national level, and similar representations have been welcomed on the Regional Advisory Council (p. 137) and the governing bodies and advisory committees of technical colleges (pp. 130–1). The T.U.C. no less than the F.B.I. is vitally concerned with the quality and development of technical education, which is a far cry from the time when education and training were regarded as a device for the greater exploitation of the worker by the employer. It is reasonable to see in education, especially in management education and training, a common meeting ground for both sides of industry.

Both sides of industry, through the Joint Consultative Committee representative of the British Employers' Confederation and the Trades Union Congress, are vitally concerned with the recruiting and training of juveniles for industry. In December, 1945, the Committee's Report thereon was accepted by the Minister of Labour and National Service, and from it has come a most important development in the setting up of National Joint Industrial Councils (N.J.I.C.) for many industries. Each scheme agreed by the N.J.I.C. usually defines the following arrangements for apprenticeships: Administration; Recruitment; Age of Entry to Apprenticeship; Registration; Probationary Period; Indentures; Part-time Education; Practical Training; Certification. It may also include such matters as Disputes; Transfers; Medical Examination; Ratio of Apprentices to Craftsmen; Classification of Apprentices, and any special matters of the particular trade or employment. The Central Youth Employment Executive supplies summaries of these schemes to Local Education Authorities, Ministry of Labour Local Offices and other interested bodies [30].

The National Institute of Industrial Psychology (N.I.I.P.)

The Institute was formed in 1921, as a result of wartime experience, as a non-profit making association for the development of industrial psychology [31]. In its early years it received substantial grants from the Rockefeller Foundation; later grants came from the Pilgrim Trust and the Leverhulme Trustees, but it has been mainly through the continued support of industrial firms and interested individuals that it has developed and extended its work. Industrial psychology or, as it is becoming increasingly known, occupational psychology, is concerned with the study of man at work and with the study of the working environments in relation to man's capacities, needs and limitations. The solutions of these problems, which include vocational guidance and selection, once arrived at in this field, can rarely be applied without further exposition and persuasion. The N.I.I.P. therefore exercises a considerable educational influence through the holding of conferences and courses as well as through the carrying out of the actual investigations, and publishes an important journal, *Occupational Psychology.*

The industrial research of the N.I.I.P. might at first sight seem remote from the work of technical colleges, but, though the time lag is long (almost certainly too long) the connection is real. As an example of close relatedness to technical college work there is the current research, financed from Conditional Aid Funds, into methods of training in industrial skills, started because comparatively little is known about fundamental aspects of the learning process in industrial tasks. The inquiry is expected to last for three years and in addition to examining such questions as Should training be given in the workshop or in a separate school? Should one concentrate first on speed or on accuracy?—it is hoped to gain some knowledge of the importance of motivation at the learning stage.

Education and Training provided externally to Industry

The provision by bodies other than industry itself is vast and varied and here are briefly classified the main ways in which industrial needs are served by other organisations.

In general terms the external provision is destined to meet the special and general needs of the medium and small sized firms and organisations, and the more general needs of the larger firms at various levels—craftsman and technician, applied scientist and technologists, designer (both artistic and technical), foreman, manager and executive. This immensity of scope is reflected in the multiplicity of means available.

1. The *Technical Institutions*, whose work is the main subject of this book, detailed for full-time courses in Chapter III, part-time courses in Chapter IV and for many specialised requirements in Chapters VIII to XV. Special mention must be made here, however, of the notable contribution of the technical colleges to management education, especially at the Manchester College of Technology, the Polytechnic, Regent Street, W.1, College of Technology, Birmingham, Leicester College of Technology and Commerce, Leeds College of Commerce, and the Scottish College of Commerce, Glasgow.

2. The *Universities* have technological departments or faculties such as engineering. These are of course very important, but except for their relation to policy in higher technological education do not come within the scope of this book. The universities are showing an increasing interest in management education, for example in post-graduate teaching in those academic subjects, such as industrial relations, applied economics and applied statistics which are also tools of management [32]. There are also more general ways, especially through Extra-Mural Departments/Boards, as, for example, in courses for 'Managers in Industry' at Madingly Hall, University of Cambridge, and Residential Courses for Young Workers (aged 18–25 years) at Holly Royde, University of Manchester. The conferences on the Education of the Young Worker held from 1948 to 1951 should be noted, and also their sequel in the Conference on Education for Human Relations, all organised by the Department of Education, Oxford University [53].

3. *Other Residential Courses* and *Adult Education Colleges* have grown greatly in number since the war, despite some recession, and are showing an increasing interest in courses with an industrial content or bias. Examples are the courses at Grantley Hall in 'Management in Industry', 'Stresses and Strains at Work', 'The Exporter's Problem', 'Productivity', 'Industrial Citizenship' or again, the courses at Urchfont Manor on 'The Human Factor in Production', 'Consultation in Industry', 'The Implications of Work Study', 'Human Problems in the Retail Trade'; or yet again 'Policy Makers in Industry and Commerce' and 'Organisation for Productivity' at Ashridge (Appendix, p. 625.)

Many of these courses at Adult Education Colleges have all the appearance of technical college courses conducted in unaccustomed rural surroundings, and it would be all too easy to be partisan or parochial in attitude towards this provision. But the needs of industry are vastly greater than all the present means to satisfy them, so that any fears of competition are foolishly out of place. It is most unlikely that the residential colleges will ever be able to take more than a small fraction of those requiring management education and training. Though regional technical institutions may expect to have residential facilities eventually, neither could they take more than a small fraction of the whole, and the aim must surely be to give the opportunity of residential education to as many as possible. Nevertheless there should be a broad distinction of approach if not of treatment. The adult residential college should treat subjects from the general adult educational humanities' standpoint but with sufficient technical illustration; the technical college should proceed from the techniques and case-histories outwards to the more general human considerations. Life is more than livelihood, technical education is not an end in itself and, whichever the approach, we should seek to prove that 'Vocational Adult Education may well provide the bridge, which has been so sadly lacking, between the technical working life and the heritage of humane culture' [33].

There have been some very interesting post-war developments designed to foster the character and general development of younger employees in industry, their use of leisure and the increased opportunities of the shorter working week. Examples are the Outward Bound School Organisation with its Sea Schools at Aberdovey and at Burghead, and its Mountain School at Eskdale [34]. Another venture is at Brathay Hall Centre, Windermere [35]. The National Association of Boys' Clubs helps with a one week's 'Adjustment to Industry' Course at Amersham which is used by firms as part of induction training. There are also the 'Girls in Industry' residential courses organised by the National Association of Mixed Clubs and Girls' Clubs [36]. Of a different kind altogether are the courses at Cheshunt College, Cambridge, where industrial students study alongside the full-time students in special courses arranged under the auspices of the National Council of Y.M.C.As [37].

A major problem of such organisations is to keep going all the year round and not simply during the popular summer months. This may pose a problem for the technical colleges if students attending day-release courses are involved. A month's absence from a course of one day per week could have very serious effects on the student's progress and likelihood of passing his examination, even with the exceptional student likely to be sent to these places. With only 14% of young employees attending day-release courses there are many others who could be sent during the period of college terms. However, the aims and work of these organisations are admirable and if possible should not be denied to those interested; as a compromise, it is suggested that no day-release students should be sent in the year of a definitive examination (e.g. Ordinary National Certificate) and not within three months of the end of the session in an earlier year.

4. *Professional Institutions.* The long-established chartered professional institutions have exercised a profound influence over education for industry and commerce. But their influence has been much wider than that on the work of technical institutions; most important of all, this has been because so large a proportion of their members are in industry and commerce, a membership which acts as an effective two-way channel for ideas and information on educational, scientific, industrial and commercial theory and practice. In these institutions cardinal importance attaches to the standards of admission to the various grades of membership by their own examinations, or by very strictly controlled exemptions from those examinations. Most of these national institutions have district or regional branches throughout the country (and overseas), and both there and at the centre frequent meetings with lectures and discussions are held. The ambit of these is greatly extended by the publication of papers in the institutions' journals. The institutions are active in promoting conferences and meetings and in making representations on education to the Ministry of Education and other official bodies. They have grown from the inspired devoted work of their founders through long honourable careers to their present eminence but, like many other human institutions, they are not infallible, nor entirely consistent in their ways, but show some human failings among much wisdom. Nevertheless, those concerned with education in and for industry and commerce should be grateful for their work and influence over the years, and be hopeful, too, of the future of those established in recent years.

Some at least of these older institutions have shown a growing interest in the non-scientific or technological aspects of their professions and have come to require examination papers in such subjects as Industrial Administration and Management.

The post-war period has seen both a growth and a strengthening of new professional and semi-professional bodies, particularly concerned with management at various levels, for example the Institute of Cost and Works Accountants (I.C.W.A.), the Institute of Works Managers (I.W.M.) and the Institute of Personnel Managers (I.P.M.) [38].

Training by Government

Sir Godfrey Ince distinguishes the work of the government as an employer—especially in the Admiralty, the Ministry of Supply (and more recently, in developing atomic energy [39])—from its work as a training organisation [40]. Its latter responsibilities include the Government Training Centres which, since the war, have been used for resettlement purposes, and for disabled persons. There has also been the work of the Industrial Rehabilitation Units and some of this work has been undertaken in the technical colleges, including the successful Business Training Scheme, which has been followed by a permanent scheme to assist ex-Regulars in a similar way.

Another important contribution was the introduction and development by Mr. F. H. Perkins, after visiting the United States, of Training Within Industry (T.W.I.) into wartime industry for the training of supervisors in the skills of instructing, of leadership, and in the improvement of methods. This is still used with its basic three short training programmes of Job Instruction, Job Relations, and Job Methods [41].

The *Special Aptitude Scheme* which is organised with State help through the Ministry of Labour by the Central Youth Employment Executive is another interesting educational development. This recognises the fact that special aptitudes are not geographically distributed conveniently near to a particular kind of industry, but are possessed by some young persons living in remote and isolated areas. If a boy or girl under 18 is shown to have 'real capacity and bent for a particular kind of skilled job in industry', and wishes to take up an apprenticeship or any other recognised course of training, but cannot do so within an hour's travelling time of his home he can apply to the Youth Employment Service who will try to help him get it elsewhere [42]. The Youth Employment Service will find him living accommodation and, if necessary, pay him a grant to supplement his wages and any allowance his parents can afford. From 1st April, 1950, to 31st March, 1954—the first four years of the permanent scheme—3,213 boys and girls were thus assisted to find their way in life. As a more particular illustration of the work, 57 boys in Grimsby were helped in 1951–2 to enter industries for which they were well suited but for which there were no local opportunities. Three apprentice draughtsmen went to Loughborough, eight general engineering apprentices to Lincoln and three apprentice electrical engineers to Manchester. Of the boys placed in other towns the number who returned home was five [43]. Rugby is exceptional in having received 455 boys under this scheme in favoured conditions, where the two large electrical engineering firms (B.T.H. Ltd. and English Electric Co. Ltd.) have converted a mansion to house them with other apprentices (p. 50).

At quite a different level but most important in their educational influence on industry are the following:

Department of Scientific and Industrial Research (D.S.I.R.) and the Research Associations

The D.S.I.R. was established in 1916, and the Research Associations have grown up with government aid, over the years since then (Appendix, p. 621). While the D.S.I.R. is wholly financed by the government, the Research Associations are financed partly by government grant and partly by industry, formerly on an appeal and covenant basis, latterly under the Industrial Organisation and Development Act of 1947 which provides powers to impose levies in support of co-operative research.

Quite apart from the very great value of the discoveries and improvements these bodies have brought to productive industry, they have exercised a very great educational influence in making industry scientifically and research minded, and their influence must surely grow even more in this respect. This has been exercised through the investigations themselves, the publication of results and annual reports, the holding of conferences with subsequently published reports of their proceedings, the holding of annual exhibitions at the various D.S.I.R. establishments, and with visits from representives of industrial firms. The D.S.I.R. has also greatly assisted advanced scientific and technological education in providing research scholarships, but it must be recorded, with regret, that while this assistance has been excellent in the universities, in the technical colleges it has been very niggardly in comparison. In 1954 there were 35 awards of value about £9,000 p.a. held in technical colleges out of a total expenditure on student grants of £266,000. Much closer co-operation is very desirable between the D.S.I.R., the Research Associations and the technical colleges in research and teaching, in visits of staff and students and in the secondment or interchange of staff. Perhaps this will be a desirable outcome from the conference held by the D.S.I.R. in November, 1953, on 'The Role of Research Associations in Technological and Technical Education', as has recently been commended to the technical colleges by the Ministry of Education [44].

Problems of Co-operation between Industry and Education

Granting that arrangements for education within industry and for education undertaken by other bodies must conform to the primacy of production, what working problems remain to be solved? Numerically the greatest work undertaken is in the technical colleges and we shall necessarily consider mainly the problems likely to arise here.

These problems arise partly from the changing conditions of industry and partly from the rate of expansion of educational facilities. Illustrative of the former is the problem of craft training. In the past, detailed craft training has been regarded as the duty of the employer, not the technical college. But with the development of specialised manufacturing methods, with better industrial management making for fewer blind-alley jobs and with a new emphasis on the interchangeability and adaptability of staff instead of a life-long narrow specialisation, many aspects of craft training have become the responsibility of the technical college rather than of industry. Up till now it has been much easier to secure release for a National Certificate or degree student than for one in a craft course leading to the examinations of the City and Guilds of London Institute or the Regional Examining Unions, and there is urgent need for industry and the Ministry of Labour to think again about this differential treatment.

With regard to the expansion of educational facilities, the problems are likely to arise both in industry and in the colleges especially in the operation of part-time day-release schemes [45]. Table 10 (p. 110) makes it appear that engineering is approximately three times more liberal in day-release than the building industry, and six times more than the chemical industries. This is not a true comparison as it takes no account of the total number employed in the industry, its administrative structure and age groupings. A comparison of the numbers aged 15 to 18 years actually released with the total of that age employed in each industry, as in Table 28, gives a better basis for discussing the problems involved [46]. The progress made in the particular industry is compared with the national average, thus, engineering is

3·69 times better than the national average, textiles at 27/100 scarcely exceeds a quarter of the national average.

TABLE 28

Proportion of Day-release of Employees under 18 Years of Age in Different Industries (1952–3)

Industry	No. of Day Release	No. Employed	% of Day-Release	Comparison with National Average (100)
Agriculture and Horticulture	600	61,710	0·97	6·6
Mining and Quarrying	22,453	45,880	48·9	333
Treatment of Non-Metalliferous Mining Products Other than Coal	742	20,140	3·47	24
Chemicals and Allied Trades	4,641	23,900	19·4	132
Metal Manufacture	2,427	25,640	9·46	64
Engineering, Shipbuilding and Electrical Goods	67,782	125,050	54·2	369
Vehicles	3,339	68,700	4·86	33
Metal Goods not Elsewhere Specified	512	34,730	1·47	10
Precision Instruments, Jewellery, etc.	510	10,240	4·97	34
Textiles	3,150	80,290	3·92	27
Leather, Leather Goods and Fur	133	5,690	2·34	16
Clothing	2,697	82,930	3·26	21
Food, Drink and Tobacco	5,380	76,520	7·04	48
Manufactures of Wood and Cork	1,311	28,970	4·55	31
Paper and Printing	7,574	50,520	15·0	102
Other Manufacturing Industries	1,429	17,350	8·24	56
Building and Contracting	28,898	82,680	35·0	238
Gas, Electricity and Water	3,137	10,720	29·2	199
Transport and Communication	10,016	65,660	15·3	104
Distributive Trades	8,970	263,560	3·40	23
Insurance, Banking and Finance	124	28,810	0·43	2·9
Public Administration and Defence	10,985	24,730	44·4	301
Professional Services	14,740	53,410	27·6	188
Miscellaneous Services	1,612	87,170	1·85	13
Total	202,854	1,376,000	14·7	

The comparisons are not vitiated by the lack of detailed figures of the employment structure of the various industries in terms of professional, skilled or unskilled occupations, and that we therefore cannot relate them to the numbers of students therefrom in various courses provided for such levels of occupations. For we are regarding this in county college terms, namely that all not in full-time education shall have education on one day a week until eighteen years of age.

Once again we may stress the unpalatable but inescapable conclusion that we are still preaching effectively only to the apparently converted. Where a high standard of technical skill and knowledge has become plainly necessary to the survival of the industry and the advancement of the individual, the financial and vocational motives have been powerful enough to compel educational progress. But even here it is still abundantly clear that the support is frequently given not so much from inner conviction as under duress of circumstance, the most powerful factor being the acute shortage of manpower. Business firms know well enough that further training by day-release is as attractive as good wages to parents and head teachers interested in placing young people in employment. That circumstances may play a stronger part than a belief in the absolute value of education is shown perhaps in the demand for evening attendance as a *quid pro quo*, and the arrangements made for deferments for released employees also show that external circumstances may be more important than inner conviction in determining the progress made in the main industries dealt with above.

It is significant that the progressive industries from the day-release viewpoint are relatively well organised on both the employer and employee sides, and that suitable courses and qualifications have been established for them. Outside this comparatively narrow field these conditions do not obtain. It is difficult to see how the system of gaining qualifications by examination could be so greatly enlarged as to cover seven times as many students and the needs of a much greater diversity of occupations, very many of which require little vocational training, while the greater part are unexaminable. For example, good though the progress has been at the beginning of providing training for the hotel and catering trade, under the exertions of the newly established Hotel and Catering Institute and with the establishment of defined courses and recognised certificates, it would be foolish having regard to the nature and conditions of the industry to hope it would emulate the engineering, chemical or building industries.

There are many circumstances which make it difficult for an employer to release young people. One of the most important is the extent to which work may be dislocated. Expensive mechanisation and redeployment of labour may be necessary to reduce this dislocation to a minimum. Then again, employers naturally look for an early return in value from the courses provided. This is not always possible and the only way out is to try more persistently to inculcate a belief in general and long-term education, which is likely to be a slow process. Even if substitute part-time employees or additional full-time people can be engaged, the additional cost is bound to be considered very closely in these days of higher wages. Such adjustments are not easy but they are easier for the larger than the smaller firm, a point of great importance when we consider the structure of industry shown in Table 29 [47].

TABLE 29

Size of Manufacturing Firms

	No. of Employees						
Size of Firm	11–24	25–99	100–499	500–999	1000–1999	2,000 or more	Total
a. No. of Firms	17,177	25,103	11,600	1,481	634	352	56,407
b. Percentage of Total	30·6	44·4	20·7	2·6	1·1	0·6	100
c. No. of Employees	294,000	1,249,000	2,427,000	1,017,000	876,000	1,372,000	7,235,000
d. Percentage of Total	4·1	17·3	33·5	14·1	12·1	18·9	100

Table 29 shows that 75% of manufacturing firms employ less than 100 people each, and that 95·7% employ 500 people or less; 54·9% of persons employed in manufacturing industry are in firms employing less than 100 people each, and 70% are in firms employing less than 500 persons. Manufacturing industry is therefore mainly composed of medium and small-sized firms. The very different structures of four important industries concerned with day-release schemes are contrasted in Diagram 23A—showing the proportions of firms of different sizes, and in Diagram 23B, showing the proportions of total employees in firms of different sizes.

The realities of Table 29, as illustrated by Diagrams 23A and 23B, will continue to dominate the progress of day-release, as any principal or head of department knows full well from his attempts to persuade firms to embark upon or increase their participation in such schemes. For the greater number of small manufacturing firms the problem of release will be acute if it is entertained at all. On the retail business side Table 30 shows there are far many more small units [48], and it is not surprising that day-release has here made little progress.

One must be a very liberal-minded greengrocer, butcher, baker, clothier, newsagent, draper, grocer, garage owner, or builders' merchant to give a lead in part-time day-release primarily for the immediate good of the employee, and the long-term benefit of industry or commerce and the nation. Not only are there internal difficulties to be faced, but also the knowledge that many a competitor does not give release, and that when the young person has finished the period of training

TABLE 30

SIZE OF SOME RETAIL ESTABLISHMENTS (1952)

Nature of Business	No. of Retail Establishments	No. of Persons Engaged	Average No. per Establishment
Grocery	129,345	478,398	3·7
Butchers	35,942	118,710	3·3
Greengrocers, Fruiterers, Fishmongers, etc.	48,162	133,226	2·8
Bread and Flour Confectioners	19,596	115,194	5·6
Confectioners, Tobacconists, Newsagents	66,312	224,941	3·4
Clothing	89,046	384,425	4·3
Hardware	30,223	111,008	3·7
Booksellers, Stationers	9,528	51,838	5·4
Furniture, Pictures, etc.	16,086	90,453	5·6
Department and Variety Stores, etc.	1,665	198,659	119·2
Builders' Materials with or without contracting	5,323	20,044	3·8
All Establishments (Note A)	531,143	2,265,291	4·3

Note A: These totals include others not listed above.

it will be difficult to retain him or her, the more especially when the young men are called up to service in H.M. Forces with all its inherent unsettlement.

Let us now assume, despite this discouraging picture, that the firm is able and willing to grant day-release, what are the problems which require the closest co-operation between industry and college? The first which crops up continually is the time of release, and particularly so with the development of new courses outside the established field. For the college it would be very convenient to have all the same group of people on the same day. This not only lightens the problem of administration in the college but, more important, it makes possible the proper grading of students, which is often a serious problem with small numbers in first-year courses. For a firm with only one apprentice or learner at a particular stage there is no great difficulty about the day of release unless the conditions of the industry prevent it. For example, the release of young people employed by retailers is not feasible on Fridays owing to heavy trade on that day. But no firm with several or many apprentices can reasonably be expected to release them on the same day, whether to the same class or to classes at different levels. The only reasonable policy for the education authority, if it wishes to develop courses rapidly, is to carry small classes on alternative days during the transitional period. To insist upon the normal

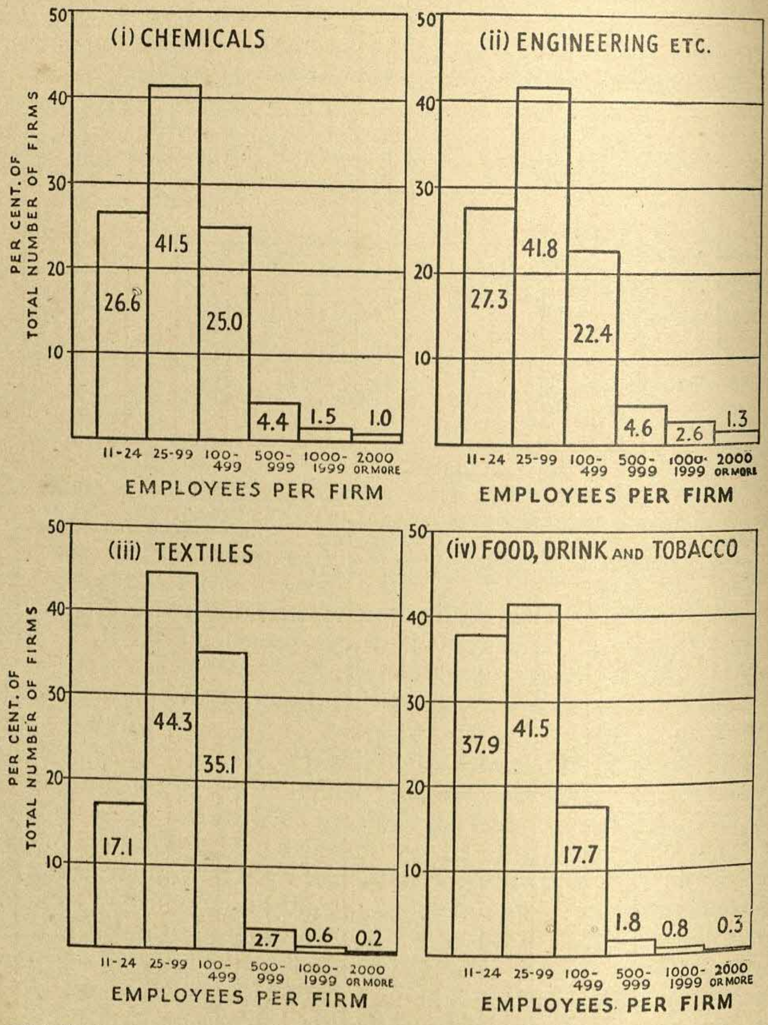


DIAGRAM 23A. THE STRUCTURES OF CERTAIN INDUSTRIES IN SIZES OF FIRMS

Source: Annual Abstract of Statistics, Table 138 (H.M.S.O., 1953)

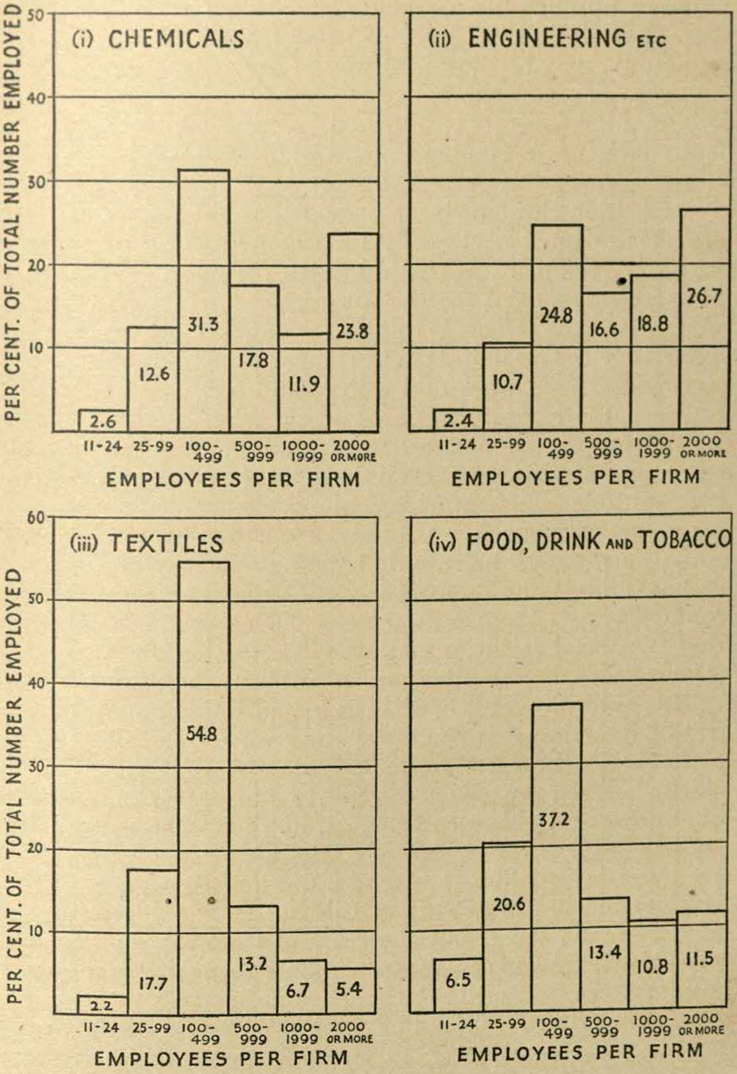


DIAGRAM 23B. THE STRUCTURES OF DIFFERENT INDUSTRIES.
PROPORTION EMPLOYED IN FIRMS OF DIFFERENT SIZES
Source: Annual Abstract of Statistics, Table 138 (*H.M.S.O., 1953*)

minimum number for a single class, say, on Monday only, rather than an initial choice of small classes on Monday and Wednesday, may be the surest way of preventing any progress whatever. To compile a list of enquiries, and wait until a pre-determined total is reached, is not an attractive or effective way of developing courses while the session is slipping by; the snowball effect must start with a handful. While private tuition can hardly be provided at the public expense, small classes must necessarily be accepted as an inescapable part of development, as the induction period of a new phase, and as an investment for the future.

Attendance at college is mostly for one day per week. This is preferable to two half-days as it means the minimum travelling time between work and college and home and avoids, in many cases, the problem of changing from working clothes required for the shop floor, foundry, mine and so forth, to those more suitable, and certainly those the student feels to be more suitable when working alongside students in other courses or coming, for example, from clerical and similar occupations. With increased changing and washing facilities this has diminishing importance, but progress is slow. Moreover all-day attendances at the college enables the student to enjoy the social facilities and activities in the lunch hour.

Day-release is regarded as a privilege accorded to the student, especially as it is without loss of wages and with payment of fees, and it is usually withdrawn for certain reasons. Chief among these is failure to pass the course, when the student is given the option of repeating his study in a parallel evening course in his own time. If he then succeeds the firm may pay his fees retrospectively, and in the following session once more permit him to attend a day-release course. From the point of view of incentives this has all the appearance of sound common sense, but there are at least two hidden misconceptions; that every student is able to pass the course at the first attempt, and that there are no hazards in examinations. The criterion should be whether he has worked reasonably and conscientiously throughout the course, and has sufficient ability to justify a second attempt under the same conditions rather than under the admittedly more arduous conditions of evening courses.

Certain employers, under duress of an agreement concerning apprentices for the industry, allow them day-release until the age of 18 and then promptly withdraw them. In some cases the withdrawal is made abruptly as a birthday present in the week in which the student, however good his work and promise, attains the age of 18; others with more consideration and more in the spirit of the agreements, allow release until the end of the academic year in which the student has become 18, so that he can prepare for and take his examinations under good conditions. The withdrawal especially of promising students at 18 years, whether abruptly or not, is the cause of both regret and irritation in the college. This is natural, for the teachers have good reason to know the greater response and promise of students in day-release courses, but these employers are already granting voluntarily what the county colleges could at most require, while seven times as many young employees do not yet attend any day-release courses. More than this, we should be most appreciative of the numbers who already stay beyond the county college age range as shown in Table 31; those aged 18 to 20 comprise about 22·5% of total day-release, and those aged 21 and over are 11·9% of the total [49].

TABLE 31

DAY-RELEASE BEYOND THE COUNTY COLLEGE AGE GROUP
(England and Wales 1953)

	18–20 years	21 years and over
Number of age group released	69,483	36,918
Total day-release (all ages)	309,255	309,255
Percentage of total day-release	22·46%	11·93%
Number not in full-time education	1,567,047	—
Percentage day-release of this number	4·43%	—

Another way in which good firms have improved conditions for their promising employees has been in additional day-release. For example, where a student is taking a Final B.Sc. (Eng.) course, he is allowed one and a half days and in some cases two days' release (p. 50).

Until quite recently almost all part-time students have attended technical classes in their own time in the evenings, and they still greatly outnumber those who attend part-time day courses. With many employers there has long been an unquestioning reciprocal arrangement that one day 'off' (sic) will entail attendance on one evening. The present position is shown approximately in Table 32 overleaf.

A comparison of line iv. with lines v. to viii. of Table 32 shows how great is the variation between colleges and there is indeed no simple pattern. In fact, while one college with 1,160 day-release students had them all attending in the evenings, another of 1,050 students had but 122 in attendance; again, at another college of 2,923 day-release students, 2,743

TABLE 32

EVENING ENROLMENTS OF DAY-RELEASE STUDENTS

i.	Number of colleges surveyed	172
ii.	Total day-release thereat	165,681
iii.	Total number of these attending evening classes	100,011
iv.	Percentage of students attending evening classes	62·2%
v.	Number of colleges with 100% attending evening classes	30
vi.	Number of colleges with 90% and over attending evening classes	50
vii.	Number with none attending evening classes	6
viii.	Number with negligible attendance (10% or less)	12

attended evening classes, while for another the figures were 2,605 and 1,675 respectively—nearly 1,100 students less in the evening and thus producing a much smaller evening load of work, and work profile (p. 73). The reasons for this variation are fairly well known but their relative importance is hard to determine. In some areas there is a determined move away from the *quid pro quo*, in others the bargain is not pressed, whilst in others again it cannot be pressed because there is no accommodation available. If it were available there would probably be a move towards the one-day-plus-one-evening arrangement.

At present the overall position is that nearly two-thirds of day-release students attend also in the evening. While this arrangement could not be required under the county college system as envisaged in the 1944 Act, it is quite understandable in a voluntary system. However, this attendance by the student 'in his own time', so desirable as an earnest of his ambitions, nevertheless can be, and still is being taken too much for granted. Recently the bargain of 'one day plus one evening' has tended to worsen for some students, whereby a full day's release or two half-days will entail attendance on two evenings. This has been met with particularly when attempts have been made to persuade employers to start new release schemes, and even in new schemes prepared by Joint Industrial Councils. It is a regrettable tendency which should be resisted, for it defeats the whole purpose of day-release schemes. Arrangements of that kind impose too heavy a burden on the young worker just at the very time when a forty-hour week is being generally regarded as the desirable aim for adults. There will unfortunately always be those who will talk of molly-coddling and point to those (including of course themselves as exemplary models) who survived the arduous conditions in bygone years, regardless of the far greater number who fell by the wayside and the evident (but not self-evident) marks of such conditions in their own outlook.

The transfer of professional and craft studies to the daytime is most desirable to lessen the burden on young workers at a time of great physical, psychological and environmental change. The time so freed should enable some leisure time to be available for wider interests, and should rarely be filled up again with other classes. An additional compulsory attendance of one evening per week may be conceded in the interim period before county colleges are established, but thereafter attendance should be optional and should not form an integral part of the course. As regards the greater requirement of two evenings, the figure given in line iv. of Table 32 does not show how far this obtains in certain courses, nor how many day-release students attend on more than one evening.

The colleges are not altogether blameless in this matter of filling up the evenings once again with more classes. A powerful influence exists to co-operate with employers in the laudable desire to allow more time to deal with existing subjects, to include ancillary subjects now regarded as essential, and generally to raise the standards of courses. The danger of overloading the student may grow still greater because of the wish to meet the increasing standards required for exemption from certain professional examinations.

Some firms find it more convenient to grant two half-days while others grant only half a day with Saturday morning attendance in the students' own time, if the five-day working week holds. Incidentally, the technical colleges are universally expected to be open from 9 a.m. to 9 p.m. or later, and on Saturdays from 9 a.m. to 12 noon in marked contrast to other educational institutions and the five-day week in industry. No wonder the staff are apt to smile wryly when proposals for Saturday afternoon classes turn up whenever the present crowded conditions of the colleges are discussed. For a college with a very heavy load of work the half-day-release poses very acute problems. If 20 student places are available and students are enrolled in order of their arrival during enrolment week, there could easily be twelve students for the whole day and eight for the afternoon session (who take an evening course parallel to the daytime one). Eight other students arriving later in the queue, with whole day-release each, would be denied this valuable privilege. In the circumstances the college is forced to have a provisional list till all enrolments are known and then give preference to those with full day-release.

There remains one seemingly intractable difficulty which haunts day-release from certain industries, but without which voluntary attendance requires the utmost perseverance on the part of the student. This is shift work, as for example, among chemical process operators who might study for the newly instituted four-year City and Guilds Course in Chemical Plant Operation. This can be overcome by offering parallel courses in two parts on some such arrangement as follows:

	Morning	*Afternoon*
Tuesday	Part I	Part II
Thursday	Part II	Part I

If the shifts are (1) 2 p.m. to 10 p.m.; (2) 10 p.m. to 6 a.m.; (3) 6 a.m. to 2 p.m., the student can attend in the firm's time on shift (1) in the afternoons, shift (3) in the mornings. However, shift (2) is the most arduous and means attendance probably in the afternoons in his own time. If he is not granted day-release, he can still attend in the mornings when on shift (1), and in the afternoons on shift (3), though here he will need to be let off early in order to start classes in time, especially if he has far to travel. Employers contemplating the easy way of no release should note how heavy are the odds against the student completing the course. This brings up the important question, of numbers in the courses, which no college can ignore. Suppose the numbers for each day for normal courses were fifteen, making a total of 30, with a flux of attendance of shift workers from several firms, there could be few in the mornings and an overloaded class in the afternoons. However, experience shows a variation from about 8 to 20. Such arrangements require special sympathy and understanding on the part of the teaching staff. The present impact of shift work in preventing the release of students is unknown, and there is need both for enquiry and experiment.

There is one administrative problem which, unless it is tackled early, is likely to cause much irritation and annoyance, especially with the recent increase in numbers. This arises from the natural expectation of a firm to receive reports on its employees' attendance and progress. Many firms provide their employees with registration/time cards to be signed twice daily by the teaching staff of the college as a proof of attendance upon which payment of wages for the day is made. With many students, up to 2,000 or more, this is a quite unnecessary burden for the college staff and, moreover, just at a time when they may expect to be dealing with special enquiries and other things at the end of the class. A survey in one college showed that in the worst period of the year the range of absences were from 6 to 32 daily, with an average of about 15, and some 75 to 80 absences each week. These are notified by the college office to the firms concerned within at most three days of their occurrence, thus saving some 5,000 signatures weekly. Of course, it is essential that these notices should be both prompt and accurate.

As for reporting on a student's progress it is natural enough to want to carry over from school the method of examinations and reports each term. With the shortage of time available for study this is also a burden and with an appropriate check it is an unnecessary one. A growing practice is as follows, illustrated by the figures of one college with some 2,200 day-release students. The system is not designed foolishly to predict or promise whether a student will pass his examinations, but to determine whether or not he is working reasonably according to his ability. During January, students' records are checked and those which are unsatisfactory or whose total records appear so, are reported by the teaching staff concerned to the head of department. In the six main departments 115 students were reported, of which 9 proved excusable through late starts and transfers from other courses. After discussions with the staff, 89 students were interviewed, and in most cases cautioned by the heads of departments, but in some cases the students were found to be working under particular difficulties which the head could try and reasonably hope to remove or mitigate. Of the 89 students 19 were sufficiently difficult to warrant the additional warning of a telephone call to some responsible person at the works—usually the education or personnel officer, with whom the case was fully discussed. Three students were so bad as to warrant a written interim report to their firms: this was exceptionally few, and the highest number in any one year since the scheme was introduced is 18. At the end of the year both the student and the firm receive a full report of the year's work, including home work, classwork, laboratory work and examination marks. This system, as well as that of reporting absences, was adopted on the unanimous recommendation of the College Advisory Committees.

Management Education and Training

Many references are made to this subject throughout this book because it is the most widely inter-penetrating aspect of industry, occupying a key position yet entering at all levels, having its own distinct body of knowledge, techniques and sanctions yet never wholly divorced from scientific, technical or commercial details. Management education and training are provided in the following ways; staff and management training within individual firms and within particular industries; co-operative arrangements between individual firms and with voluntary and professional bodies; management education at technical colleges, at residential adult education colleges and at universities, and schemes fostered by the British Institute of Management [50].

The literature of management education and training has become voluminous since the war, and now encompasses an ever-widening range of journals and other publications [51]. The help of the library and information service of the British Institute of Management will thus become still more indispensable to those interested in management problems.

Good enlightened management is vital to the establishment and success of effective schemes of education and training, both within the firm or industry, or in co-operation with other bodies. Lip-service at top-level deceives no one, nor does it at any other level for that matter, and it is vital that not only should the management appear to be keen on education in glossy brochures but they must be found to be keen on it in the everyday life of the firm. This must be seen in the active application of otherwise paper schemes, and an insistence that progress through these will be inseparably linked with promotion in the firm.

There is the important question of staffing the education and training work undertaken in the firm. At what size of firm does it cease to be efficiently catered for by the part-time work of someone mainly engaged in production or more likely in general administration? At the other end of the scale, when does a separate training centre or education department become justifiable, indeed, necessary with a senior ranking appointment commanding general respect and ensuring that educational requirements are not overborne by the exigencies of production? Is it possible to discern general criteria of sufficient application to make it possible to judge the adequacy or efficiency of the existing provision? These and other answers are far to seek, but what is obvious already is the emergence of a new professional cadre of education and training officers in industry; so much so that already there has recently been active public discussion on the desirability of forming a professional association for them [52]. The general tenor of the discussion was in favour of concentrating resources and using existing organisations such as B.A.C.I.E. and I.P.M., but it will be surprising if the usual evolution of a professional body does not take place, for their work is of growing importance and significance and there is also a sufficient identity of interest.

The British Institute of Management (*B.I.M.*)

Once again the exigencies of war quickened a process of development, and in recognition of this the Government, through the President of the Board of Trade, set up in November, 1945, a Committee, under the Chairmanship of Sir Clive Bailleu, K.B.E., C.M.G., to formulate detailed proposals for setting up a central institution for all questions connected with management. The Bailleu Report was published in 1946 [53], and as a result the British Institute of Management was founded in 1947 with a government grant of not more than £150,000 over five years to supplement contributions from members and from industry. Its main income now is from subscriptions from companies and individuals, and from the sale of publications, and this is supplemented by a grant-in-aid from public funds.

In pursuit of its broad aims, the Institute provides or arranges the following: a comprehensive information service covering all aspects of management, including a reference and a lending library; publishes handbooks and papers on different aspects of management; organises conferences, lectures, study-groups, etc.; conducts or facilitates research into management problems; stimulates interest in the subject of improved management by every possible means; by the co-ordination of allied activities and latterly, especially by the formation of local management associations for the local exchange of experience; maintains for its corporate subscribers a Register of Management and Industrial Consultants [52].

The B.I.M. is a non-political and non-profit making body, and it is not a teaching body, though it concerns itself closely with the development of education and training for management on a national scale. Its activities thus include the administration jointly with the Ministry of Education of a national scheme for certificates and diplomas in management studies, based on part-time courses at present operating in some 60 technical and commercial colleges throughout the country. The natural ultimate aim of much of this education is a professional qualification and the Bailleu Report recommended that 'the Institute should aim to establish itself as a professional body having defined grades of membership of individuals, the highest standards being set for admission to the top grades'. Since 1919, however, the Institute of Industrial Administration had been active in this field. Although its early days had witnessed a hard struggle for recognition, and even for survival, it enjoyed during the 'thirties rising prestige and increasing membership. It was clearly undesirable that the two bodies should remain independent with the possibility of dissipation and overlap of effort. After protracted negotiations the Institute of Industrial Administration merged with the British Institute of Management in 1953 'to promote the science of management within the framework of the British Institute of Management' of which it now forms the professional wing. There are thus two types of membership; the non-professional (Associateship, studentship and individual subscribership) which does not entitle the use of designating letters, and secondly, the professional qualifications of Fellowship (F.I.I.A.), Membership (M.I.I.A.), Associate Members (A.M.I.I.A.).

Two types of management qualifications are available based on examinations, namely the Intermediate Certificate and the Diploma in Management Studies. Examinations are conducted by the Institute of Industrial Administration for each of these qualifications. In addition, however, approval has been given to a large number of schemes operated by technical and commercial colleges leading to these awards. The colleges conduct courses on approved syllabuses, which are not necessarily standardised, and set their own examinations.

In the interests of uniformity of standards a system of external assessment is operated whereby examination papers and scripts are subjected to independent scrutiny by an assessor appointed by the British Institute of Management. Under this system every subject is assessed at least once in three years—a compromise arrangement arrived at after very prolonged discussions with the representatives of the technical colleges, and one which should be eased with growing experience of the work of the colleges. Separate systems operate for England and Wales and for Scotland though they are broadly similar in structure and content.

Among recent developments is the Institute's Survey, *Education and Training in the Field of Management*, which lists 190 technical and commercial colleges and colleges of further education giving instruction in management subjects; of these 76 have been approved for courses of instruction leading to the Common Intermediate and Final Diploma of the National Scheme. A new experiment is the B.I.M. Executive

Development Programme designed to assist the personal development of executives, normally in their thirties, who are entering the range of possible promotion to higher responsibilities. There is the wide gap, which it is designed to fill, between the courses of three months at the Administrative Staff College, catering for experienced top grade executives on the one hand, and the part-time five-year Diploma course in Managerial Studies on the other. The concentrated residential course of four weeks' duration gives a broad appraisal of general management, its climate, functions and techniques, and should stimulate personal development.

College Staffing Matters in Relation to Industry

Conversely we may look from the college outwards to industry and briefly note some important staffing matters. There is the utmost need for a two-way traffic between industry and college—of visiting part-time specialists from industry into college for the good of both students and staff, and frequent visits of technical college staff to industry. Peripatetic tours with a purpose and a discerning eye are important but they are not enough; some more permanent transposition is essential. Arrangements were made in March, 1946, under the Ministry's Admin. Memo. 134 for the easier release of teachers to industry, but a letter to the Local Authorities in April, 1954, regretfully notes that during as late a period as 1st October, 1952, to 30th September, 1953, only 21 teachers, from seven establishments, were able to make these arrangements. The hoped for increase may come with easier staffing conditions but we cannot be very sanguine—the indifferent teachers will hardly be welcomed and they would perhaps gain most; if the first-class teachers go they will hardly come back, with comparatively indifferent salary prospects. Other methods should certainly be tried: secondments up to three months, especially to research establishments and the research associations, or, with the earlier termination of 'sandwich' courses there could be part-week arrangements for definite commitments in industry. More promising perhaps is a system of interchange of two persons between industry and college, on one condition, that the full-time teaching appointment permits consultative work on American lines without drastic salary conditions being imposed.

Other Assistance Given by Industry to Technical Education

Enlightened industry gives assistance in many ways, of which perhaps the most usual are the following; gifts of materials and equipment; loans of equipment and rental of large expensive machinery at rates advantageous to the college; advice on the planning and equipping of new buildings; donation of prizes and other awards; payment of students' fees, and of wages during the college periods of 'sandwich' courses; provision of scholarships both on a national basis by employers' federations and trades unions and similarly at individual colleges of grants and scholarships for research. Much of this expenditure ranks for income-tax rebate under the provisions of the *Ministry of Education Circular* 281 (1st October, 1954). It would be very interesting to know what the total expenditure thus ranking for rebate has been in recent years.

Industry has also co-operated in other, less directly financial ways, as in arranging works' visits to see work in production, and developments and installation on the site. Something is done by way of supplying long-term research problems for investigation in the technical colleges, but far more might be done both by firms and research associations—with suitable safeguards, e.g. for industry to have prior access to the results, and for the college in reserved rights of publication after a strictly limited period. Industry also co-operates in providing vacation experience for students, both from home and abroad (the latter through the work of I.A.E.S.T.E. [54]).

Industry, Education and Recruitment

Lastly, we come back to manpower and recruitment, which is indeed the underlying theme of this chapter. Thus we have the siren song to schools at many a conference with careers masters [55], but we also have the recurrent undertone of complaint at the poor standard of education of those entering industry from the schools (possibly not the same schools). Sir John Buchanan reported, as a result of enquiry, that 56% of the manufacturers were dissatisfied with the educational standards of recruits to industry from the secondary modern school. In his view it was not good enough to say education was as good as it was before the war: in the modern world it should be much better [56]. Latterly complaints have risen almost to a crescendo on the evils of specialisation. In abandoning the metaphor before it becomes as inharmonious as many of the cries of complaint raised against our educational system, let us not fall into another popular one about 'scraping the barrel'. The progress of civilisation and education are both upward spirals which can never be accurately matched, and mankind's ascent to ever more exacting tasks must necessarily point its inadequacies and backslidings. Increased expectations mean severer judgements on shortcomings, real or imagined, and give us a false estimate of what has already been achieved by those no better than others similarly condemned on lower standards in former times.

Nevertheless, industry is right to set its standards as high as possible and to use every means to secure and select ability for its varying levels of skill and responsibility. This puts a premium on vocational guidance, and good relationships with the schools, colleges and universities. It should mean a readiness to change traditional methods, as for example the need to change apprenticeships to take account of rising educational standards, both as to age of entry (for the ex-grammar or secondary schoolboy), and as to length of apprenticeship because of the greater efficiency of training, or the development of modern production methods and materials. Many means should be employed to inform potential recruits as fully as possible of all that is involved, and this is the reason for the firms' many magnificent brochures which put most technical colleges prospectuses in the shade as regards the colour and wealth of their illustrations (expense is no bar when human ability is the most precious of all raw materials). Visits from scholars and students to industrial premises are now a commonplace, though judging from some reports some of those who conduct them ought to read the entertainingly instructive pamphlet *A Guide to the Proper Treatment of Factory Visitors* [57]. None of the former groups are outside its courteous scope and it would deserve an equal circulation in the colleges.

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CHAPTER VII

SELECTION AND PLACEMENT IN TECHNICAL EDUCATION

IF the preceding chapter has one clear lesson it is the great scarcity of human ability in relation to present and future tasks, both with regard to the technical requirements of occupations in themselves, and the social and economic need to provide for an ageing population in an ever increasingly competitive world. It is almost certainly true that the particular firm 'briskly disowns any purely benevolent intention and hopes devoutly that training will never be confused with welfare. One finds, of course, that the results are generally beneficial and that company managers regularly draw attention to the happiness of their working communities as the first and most impressive outcome of training. But the declared aims are, first, greater efficiency and, second, a continuous assessment of human resources to ensure that people go into jobs for which they are best suited' [1]. Nevertheless in democratic terms, any firm which employs an individual in a job for which he is not reasonably suited in terms of ability and aptitude is denying a fundamental part of human right to happiness. The fact that this right has been granted to so very few, an almost infinitesimally small proportion in the course of human history, does not deny its validity, nor that the right derives primarily from the individual, not from the State and not from industry, whether nationalised or not. The fortunate congruence of some cases of industrial efficiency with human happiness should not deceive us as to where the true values reside, though we are by now less prone to speak in dehumanised terms such as 'hands' and 'economic man'.

Controversy is inseparable from this subject, especially where the problems of selection and placement are, as they mostly are, linked with financial awards, whether these are scholarship grants or rises in pay. Thus the problems are not and never can be purely academic matters, but there is the most urgent need for a large scale yet profound academic study of the basic conditions and validity of selection in further education and within the firms themselves. Very few investigations have been made, and until recently the problem of selection seems hardly to have arisen after the great divide of the eleven plus examination. But with the greatly increased number of state scholarships and local education authority awards there has been much controversy about the alleged wastage of public money. This has been mainly about the subsequent failure of some of those granted such awards, thus questioning the validity of selection based solely on the student's performance in the Advanced G.C.E. examination. There is controversy too about the number of awards made to encourage more students than ever to take Arts degree courses at a time when there is a serious shortage of scientists and technologists, which raises the acute problem of aptitudes and interests in the determination of awards.

Though, as has been repeatedly stated, the work of the universities does not come within the scope of this book, it would nevertheless be unreal to ignore the current controversy over selection for the universities. This is partly because of the high ability of many students who attend advanced courses in technical colleges, full-time and part-time (and the total number of students in such courses is greater than in the universities, p. 526), and partly because the principles under discussion are much the same, though the conditions under which they operate are somewhat different.

Reference must be made to original contributions and discussions, and especially to Dr. F. W. Warburton's admirable survey of the problem [2]. Here we may note that in almost all cases selection consists of the existing methods of performance in the General Certificate of Education, Advanced Level, headteacher's reports, a form requiring biographical data and, to a less extent (though increasingly) a personal interview. That these methods have shortcomings was shown in its report by the Ministry of Education Working Party on University Awards which cited evidence from one university covering the period 1935–41 [3]. The Report recorded that, in one university, of the students who took good degrees 46% obtained marks on the Higher School Certificate which would not have qualified them for awards. In some universities or constituent colleges there may be some additional entry test, especially for the borderline candidate. This was so at the London School of Economics and, in 1952 at the Conference of the Home Universities, Sir Alexander Carr-Saunders gave some results of an analysis of the results of selection. In 1949, 305 full-time students were admitted to read for the degree of B.Sc.(Econ.) all presumably with a high expectation of taking the degree in 1952. In fact 207 did pass. Of the 98 who did not, 35 were not failures for they transferred to other courses, or withdrew for personal or other accountable reasons. Sixty-five failed, mostly at the end of the first year, and of those who persisted to the Final only 2% failed. The records of the failures at entry showed that 41% of these had been considered first class, 48% good and 11% adequate. These results are not quoted as typical but simply as facts in a thoroughly investigated case; nevertheless they should give pause to critics of wastage in certain technical college courses where the range of ability is much greater and the hazards to continued progressive study are very much greater still.

To the foregoing methods of selection may also be added two other methods, firstly, pencil and paper tests of general intelligence, special ability, aptitudes, attainments, general knowledge and temperament and, secondly, group interview techniques similar to those used by the Army and the Civil Service. All this would be well if it could be managed with the numbers awaiting admission, and *if* the cumulative effect were one of increasing efficiency of selection, that is with an increasing correlation between the initial entry tests (of all kinds taken together) and the final examination result. Conversely there could be cumulative error in the use of many methods or, at least, no greater degree of certainty in the selection process.

To-day, when there is so much talk about raising standards, not least in the technical colleges and the professional institutions, there is need to heed Dr. Warburton's caveat that in the matter of selection 'Raising or lowering the standard of admission will not help. The effect of raising the standard is to reject a greater number of candidates who would have succeeded, had they been admitted to the courses. If the standard is lowered there will be an increase in the number of subsequent successes together with an increase in the number who eventually fail. From the point of view of selection, the adjuster of entrance standards sits on the horns of dilemma. He loses on the roundabouts what he gains on the swings. The proportion of errors in selection is largely independent of the academic standards demanded' [4].

This has very direct relevance to the difference in practice between British universities, the American State universities and the British technical colleges. For the British university the entry standard is high even with the post-war doubling of numbers. Though sometimes not as predictable as generally expected (as shown above) the subsequent pass ratio is consequently high; many failures have been excluded but so have able students and, it should be noted, by prior selection *outside* the university through the General Certificate of Education, Advanced Level, and—let it not be overlooked—at the Ordinary Level also. For the American State university there is no similar immediate problem of selection, for every American boy or girl who passes out of High School in the top half of the class has a right to go there. The result is a 'failure' rate within the university which to untutored British minds is astonishingly high; as much as one-third are 'flunked out' in the first year, and perhaps as little as a third of those who enter gain a degree. This is a consequence of the lower standards of entry, which do not necessarily imply much lower standards in the final examinations; indeed without such failure rates the standards would be much lower. Thus the selection takes place mainly *within* the American university, and in this there is a great similarity with the British technical college. For if the student complies with the entrance requirements for, say, a degree course he will be accepted but, if not, he will be recommended to a lower course for Advanced General Certificate of Education and thus by a course within the college will prepare for later stages of the degree course. Those who wish to gain professional qualifications may do so by graded series of courses, e.g. for Ordinary and Higher National Certificates and by endorsements in subsequent years. Here again and more markedly the selection takes place within the overall period of training, and it is fashionable to comment on the high wastage in the earlier years of such courses.

We should not expect selection methods ever to be perfect, for quite apart from the inherent errors of the methods employed, it is human beings, not inert materials which are the subject of investigation in each case—subjects who are interested in and affected by the process itself, and who mature at different rates. But neither should we be content with using less than the best group of methods obtainable, and it is noteworthy that as the result of the research of the London School of Economics, their failure rate could be reduced by the use of tests of all types from 15% to about 3 to 4%. Correspondingly there would be a rise in the quality of students and in the proportion of good honours degrees obtained. The question is whether 3 to 4% is a reasonable error of selection at this level, and with such a pre-selected group of students who have in fact undergone several selection processes, at eleven plus and at Ordinary and Advanced G.C.E. Levels; with it goes the related question of a justifiable expenditure of public money to cover this inherent experimental error for no human selection can be 100% correct. It would go hard with the provision of higher education at the present time if students were given grants on so narrow a margin.

In the technical colleges there are several factors operating which make for a quite different emphasis from the universities. In the first place, external standards of entry are set for many courses, as for example those leading to London University degrees and to the Associateships of professional institutions such as A.R.I.B.A., and A.R.I.C. These must be complied with but, as already noted, some preliminary qualifying course is usually available for those who require it, whether because of some misfortune or examination failure, or because of an ambition developed in later years. The same is true for college courses, but from practical experience of many such students and their subsequent progress, technical college staff are not always inclined to draw a hard and fast line, but rather give the student the benefit of the doubt where this is possible, even in exceptional cases allowing the student to finish off a preliminary educational requirement while starting on the main course.

Another aspect is that for the general run of technical institutions—technical, art and commercial—the position is rather one of placement in appropriate courses rather than selection out of a single course or a very limited number of courses. Further it has been more largely a question of selection by training than absolute selection before training, but the position is changing. The second factor is the much larger number of students now coming forward, raising problems of selection which are not met by a kind of passive reliance on selection by training, wherein a student repeats a course two or three or more times, as for example, is not unknown in National Certificate courses, wherein a repetition of one year of the course is the norm. When all allowances are made for adverse factors (p. 515), it is clear that many students are taking these courses who ought to be taking craft courses which are less exacting theoretically. One problem is therefore that of selecting candidates for National Certificate courses and placing the others in more appropriate courses.

The third factor, peculiar to the technical institution, is the pre-selection by industry itself, which is not as horrifying or stultifying as some in academic circles would suppose. If it is well done, as is undoubtedly true with some firms, then there is an advantage gained, and not least because there is greatly added incentive in the firm's interest in and support of its specially selected employees; if it is not well done, the effects are seldom irrevocable if the college commands respect through proven close co-operation with industry. Admittedly there are those unfortunate cases where the firm insists it has a winner who simply must take the O.N.C. Course; in the event, either the firm is convinced by the lack of progress, and the student is transferred to another course and possibly changes his job or simply makes no advancement; or yet again, the student leaves both firm and college, or the firm's insistence is part of the unreality of its training scheme which must ultimately break down with consequences we shall not follow here. This pre-selection by firms applies in greater or lesser measure to all in part-time day courses, to many in evening courses, and best of all, in close co-operation with the colleges, in the selection of students for works-based 'Sandwich' Courses (p. 86). The selection in firms, where it is under the care of an education or training officer and possibly a psychologist, can be quite involved and searching, as for example, where in addition to the usual interview and filling of forms the following tests are given to all non-staff males at or before 16 years of age; verbal intelligence test, non-verbal intelligence test, form relations test, theoretical mechanical test, practical mechanical test, arithmetic test [5].

The technical institutions are not so greatly concerned with the student's previous schooling as to discover what ability he possesses, and then to place him in an appropriate course so that it may be fostered and fructify. This is an idealistic, too inclusive a statement perhaps, but true enough in the main, for the colleges are prepared to receive and foster ability at different levels from whatever quarter it may come. In this connection the figures in Table 33 [6] are surprising to many people:

TABLE 33

ORDINARY AND HIGHER NATIONAL CERTIFICATES IN MECHANICAL ENGINEERING, 1952–3

Previous Education of Successful Candidates

	O.N.C.	H.N.C.
Secondary Grammar	47%	45%
Secondary Technical	29%	32%
Secondary Modern	24%	23%
Total Number of Certificates Awarded	5,872	2,712

The figures for other National Certificates are not available but figures from individual colleges, given in Table 34 [7], show that all three sources are fully represented for all the different Higher National Certificates gained:

TABLE 34

Higher National Certificates, 1953

Previous Education of Successful Candidates from Individual Colleges

	College A		College B		College C		College D	
	No.	%	No.	%	No.	%	No.	%
Secondary Grammar	28	26	22	35	45	54	68	35
Secondary Technical	56	52	27	44	13	15	69	35
Secondary Modern	23	22	13	21	25	31	59	30
Total	107	100	62	100	83	100	196	100

The Higher National Certificate Course is a strenuous one [8], and leads towards professional status, and in Chapter III it is urged that the ablest students should increasingly be transferred to Higher National Diploma 'Sandwich' courses of duration and standard fully comparable with university degree courses, and gaining full exemption from examinations for associate membership of professional institutions. These facts and this route should be made widely known to the staff of modern schools, and especially to those parents 'who feel that failure to get into a grammar school irrevocably damages a student's career'.

With such differing backgrounds we may ask what are the factors determining a student's success in his course and career. Is intelligence the sole or determining factor, or is there just a requisite minimum for a particular occupation or series of occupations? We may briefly list and discuss the factors under the following headings:

i. Intelligence and aptitudes.
ii. Home upbringing and economic circumstances.
iii. Schooling.
iv. As largely influenced by i., ii. and iii. the student's character and will and his interests.
v. Attitude of employers and general conditions of work.
vi. Choice of employment as influenced by (*a*) locality and choice of industry; (*b*) population factor, as in the ratio of young people to an ageing population.

Such a classification provides a positive way of looking at a student's career as distinct from the list of hazards in Chapter IV (p. 119).

It is questionable how far individuals work reasonably to the limit of their innate intelligence or, rather, how far an individual's occupation is continuously exacting in its demands on the person's intelligence. That there must be considerable reserves and latitude in this respect would seem to be true from the spread of intelligence found among those having similar occupations. Moreover the atmosphere or general air of expectation in the job and in the community may set a limit to the efforts made to solve problems, which is none the less effective though it is never explicit. The tendency to the norm, to accept and conform to the social pattern is very strong, and often effectively sets a limit both to the exercise of intelligence and also to the development of the individual's aptitudes and interests in a society such as ours, hitherto characterised by stability rather than by mobility and the notion that 'the sky's the limit'. Social mobility in Britain has increased since the war and is being quickened by developments under the 1944 Education Act, yet while we may be grateful for our traditional stability in an uncertain world, we may doubt whether the rate of change is quick enough in some directions [9].

Do we utilise the nation's intelligence and aptitudes as fully and as quickly as we may? Few would be content with a simple affirmation to this question and it may be as well to look somewhat closer at the ability to be found, for example, in a reasonably representative sample of students taking Ordinary National Certificate and craft courses respectively. In 1953 A. H. D. Tozer and H. J. C. Larwood reported testing 262 graduates in a University Education Department with the National Institute of Industrial Psychology (N.I.I.P.) Group Test 33, and these are shown in Table 35 as Group C [10]. In 1950 the same N.I.I.P. test was given by E. C. Venables to 494 first year students, 241 starting the O.N.C. Course and 263 the craft courses [11] and the results are shown in Groups A and B of Table 35.

As confirmed by the standard deviations the highly selected university graduates are a much more homogeneous group compared with the O.N.C. students and still more so compared with the craft students. Nevertheless 57% of the O.N.C. students and 23% of the craft students are within the same range of ability as the university graduates.

The N.I.I.P. Group Test 33 is a verbal test of intelligence and it is useful to compare the results with those of a non-verbal test. The results obtained by E. C. Venables with these same 494 students are given in Table 36, Columns D and E, in comparison with the results of three groups obtained by T. C. Raven [11, 12]. These latter are shown in Table 36 as Column A—Mechanical Engineering students, Column B—

Technical and Commercial students and Column C—University students.

TABLE 35

TEST SCORES OF SOME UNIVERSITY GRADUATES, ORDINARY NATIONAL CERTIFICATE (O.N.C.), AND CRAFT STUDENTS (GROUP TEST 33)

Test Score	GROUP A 1st Year O.N.C.		GROUP B 1st Year Trade/Craft		GROUP C Education Dept. Graduate Students	
185+	0	57% of total	0	23% of total	5	100% of total
165–184	1		0		86	
145–164	11		6		110	
125–144	45		16		50	
105–124	81		38		11	
25–104	103		191		0	
Total Number	241		253		262	
Mean Score	108·18		86·33		156·31	
Standard Deviation	23·18		27·52		16·19	
Note comparison with Group C	57% are within the same range as Group C.		23% are within the same range as Group C.			

TABLE 36

ANALYSIS OF NON-VERBAL TEST SCORES (RAVEN'S MATRICES, 1947) FOR VARIOUS GROUPS OF TECHNICAL COLLEGE STUDENTS AND OF UNIVERSITY STUDENTS

Test Score	COLUMN A Mechanical Engineering	COLUMN B Technical and Commercial	COLUMN C University Students	COLUMN D 1st Year O.N.C. Students	COLUMN E 1st Year Craft Students
48–45	0	0	0	0	0
44–41	0	2	2	5	0
40–37	3	7	28	11	2
36–33	8	40	65	37	11
32–29	33	48	53	74	34
28–25	44	30	19	59	62
24–0	64	24	3	55	144
Total Number	152	151	170	241	253
Mean Score	24·9	29·8	32·9	28·18	22·96
Standard Deviation	6·1	5·1	3·9	5·98	6·89
Comparison with University Group					
a. With score 29 or above	29%	64%	—	52%	14%
b. Within the same range as University group	57%	84%	—	77%	43%

Table 36 thus gives general support to the conclusions to be derived from the preceding Table, namely that there is a very definite reserve of ability of potential university calibre in the O.N.C. courses and to a much less but not negligible degree in craft courses. In this connection it should not be overlooked that these students, though not as highly selected as the university group, are also a select group by virtue of being day-release students. They are part of the 14% of the age group not in full-time education who are on day-release which, of itself, implies interested firms and some, even good selection procedures.

In view of the present concern about schooling, the results obtained by Mrs. Venables are analysed in terms of the previous schooling for 428 of the same first year technical college students [11]. This analysis is given in Table 37.

TABLE 37

TEST SCORES AND PREVIOUS SCHOOLING OF SOME ORDINARY NATIONAL CERTIFICATE AND CRAFT STUDENTS (N.I.I.P. GROUP TEST 33)

Test Score	1ST YEAR O.N.C.									1ST YEAR CRAFT									Total
	Secondary Grammar			Secondary Technical			Secondary Modern			Secondary Grammar			Secondary Technical			Secondary Modern			
	*P	*F	*Tot.	P	F	Tot.	P	F	Tot.	P	F	Tot.	P	F	Tot.	P	F	Tot.	
185+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
165–184	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
145–164	8	2	10	–	–	–	–	–	–	1	–	1	–	–	–	2	–	2	13
125–144	20	4	24	4	2	6	7	5	12	5	1	6	1	–	1	6	1	7	56
105–124	13	5	18	11	10	21	13	11	24	5	0	5	4	1	5	10	3	13	86
25–104	5	7	12	18	18	36	23	29	52	2	4	6	9	2	11	84	71	155	272
TOTAL	47	18	65	33	30	63	43	45	88	13	5	18	14	3	17	102	75	177	428

* P=Pass; F=Fail; Tot.=Total

This limited sample shows selection of ability undoubtedly to have taken place but by no means so clearly or definitely as some would suppose. It also shows that ability alone cannot guarantee success, in confirmation of everyday experience that people of less intellectual ability may do better in life because of other factors such as having, not least because of their upbringing, a stronger will and firmer resolve to succeed. It is impossible arbitrarily to separate the powerful influences ii.–iii. and v. listed above (p. 225), either from themselves or from a consideration of innate intelligence and aptitudes. This is by no means peculiar to technical education as witness the uncritical advocacy of supporters of British public schools, for example in the ever-recurrent correspondence to *The Times*. By analysis of *Who's Who* there is shown their preponderant contribution to the leaders of the nation in all walks of life, overlooking the different aspect this wears if those whose family names also occur in *Debrett* are separated in the analysis. Thus the influence of such homes and assured social status (as indeed is true of most if not all of the homes concerned) is apt to be assumed as a virtue of the public schools in the claims made for their ability to form character and inculcate social poise and acceptability. The preponderant effect of home life—for good or ill—is seen in all walks of life—and good parents can take continual encouragement from this fact. A student of average ability with a good home background may very well do much better in life—not only financially but in personal satisfactions and pleasures, and in service to the community—than one of good ability but unfortunate enough to have an indifferent or unsatisfactory home. The building student whose father is a successful builder is more likely to succeed than the student whose father's work is unrelated; for the one there is not only the increased opportunity of direct contact with the application of his studies, but also genuine family encouragement and the personal incentive of eventually succeeding to the business; while for the other to the lack of such direct contacts may be added indifference through lack of interest.

Similarly no two schools are alike even with comparable resources as under the same local authority; one will have more able, more devoted staff and have a greater proportion of parents interested in supporting its work in ways beyond what may be expected from the rates. It thus becomes known as a more desirable school and thus attracts better recruits—nowadays it is a determining factor in choosing where to live when father gets another job or is moved to a new town. The influence of a good school added to that of a good home gives a continuing good result far beyond schooldays which is not expressible in arithmetical terms. The conjunction of these two influences is shown in a greater period of schooling, and, conversely, where the school is not backed up by the home mainly through economic circumstances and the temptation of large wages, there is the acute problem of the early school leavers, for example of some 16% below 16 years of age from the grammar schools [13].

No apology is given for discussing all the foregoing matters in a chapter on selection, for which the procedures should be improved in order to secure equality of opportunity as nearly as possible, but these imponderable influences will always prevent uniformity of opportunity or the use of that opportunity when it is offered. To deny this is either to be unrealistic or worse, to be guilty of a sour-tempered egalitarianism which would seek to deny or severely limit the exercise of such favourable influences. Because some have unfavourable homes and poor circumstances, the rest shall be prevented from any advantage if not penalised—the misguided gospel of equality of opportunity by levelling down, the gospel of Social Envy substituted, as Professor S. E. Finer has noted, for the gospel of Social Aspiration [14]. In sum, while definite trends will show in the selection of ability, the results will never be very tidy or completely classifiable.

Technical education is different from the rest of education in having another powerful influence in aiding its work. This is the influence of the firm on part-time day and evening students, and on students attending sandwich courses. This may be shown in many ways—payment of wages and fees, prize schemes and salary increases on passing examinations. The money incentive is acknowledged and powerful and ought not to be despised by the pure academics who have their schemes of special prizes, open scholarships and the like. The increased wage or salary and, perhaps more, the increased status have a most powerful reinforcing effect on students' progress and success in the examinations. But it would be unjust to the firms concerned to record only the cash nexus and ignore the quite genuine human interest shown by them, especially their education staff concerned with the apprentices and trainees. At its best it is no alleged capitalist abuse of terms to talk of a family atmosphere and loyalties, and to prove one's worth if not to shine in such company is indeed a great incentive. Most colleges know where their best students are likely to come from.

At the present time too many jobs are seeking too few young people and this has certain consequences which are likely to continue with an ageing population. The first is that the young people may gain an undue sense of their own importance, especially where earnings are high in some occupations. They may turn their wishes into demands and set them too high, with consequent difficulties of settling in or a rapid sequence of jobs not seriously tried at all. Despite all the annoyance and trouble thus caused, this is preferable to the unemployment queue with each hoping to seize any job however unsuitable or distasteful and then, fearing to lose it, becoming embittered or at best reconciled to a regrettable necessity for life. The solution is not to gird at the immaturity of young people but to influence and assist them through the Youth Employment Service, and by proper reception and induction schemes in the firms [15].

Secondly there is the changed meaning of selection in these circumstances. Dr. H. T. Himmelweit has pointed out for university selection 'if there are roughly as many vacancies as there are prospective students wishing to enrol, tests might still be given for the sake of guidance or experimentation or for other reasons, but from the point of view of selection they would be quite useless as every applicant would be taken anyway' [16]. The emphasis thus changes to guidance and placement of those available, rather than a competitive selection for a limited number of places.

There is the question of the degree of ability required in the job, for as is well known, too great ability is apt to lead to frustration and discontent (and is a waste of ability anyway), and insufficient ability besides producing unsatisfactory work is very likely, through constant strain, to make the person very difficult to get on with and even to lead to ill-health, if not to a complete breakdown. There is no single absolute level of ability required for a given job and it may be performed by people with differing abilities. Satisfactory performance must not differ too widely (with frustration and strain as the upper and lower limits), but there is a wide spread of ability compatible with a given occupation. Diagram 24A shows this for a series of occupations in the U.S.A., and Diagram 24B for occupations in Britain. The range is independent of the community in which people live, whether American, British or whatever the nationality may be. There is no absolute difference between successive occupations, and an individual could, according to intelligence, be successfully employed in a series of occupations. Intelligence is not, nor is likely to be the sole deciding factor in the choice of employment.

One difficulty of such occupational classification is the variety of levels with the same name, e.g. clerks from such dissimilar occupational groupings as the Civil Service, works offices, accountants, railway, shipping and insurance clerks. The name 'mate' may mean anything from a highly skilled apprentice to a low grade labourer [17].

The width of the band for each occupation takes no account of the competence with which the tested men performed their work. If some criteria of competence were applied to all the occupations the bands might very well be much narrower, but the trends would be much the same and there would still be overlap between successive occupations. Thus it would be reasonable to advise someone with a low score and high ambitions that it was improbable that he would succeed, that he should lower his sights, and be content with O.N.C. instead of H.N.C., a craft course and not an O.N.C.; and someone with

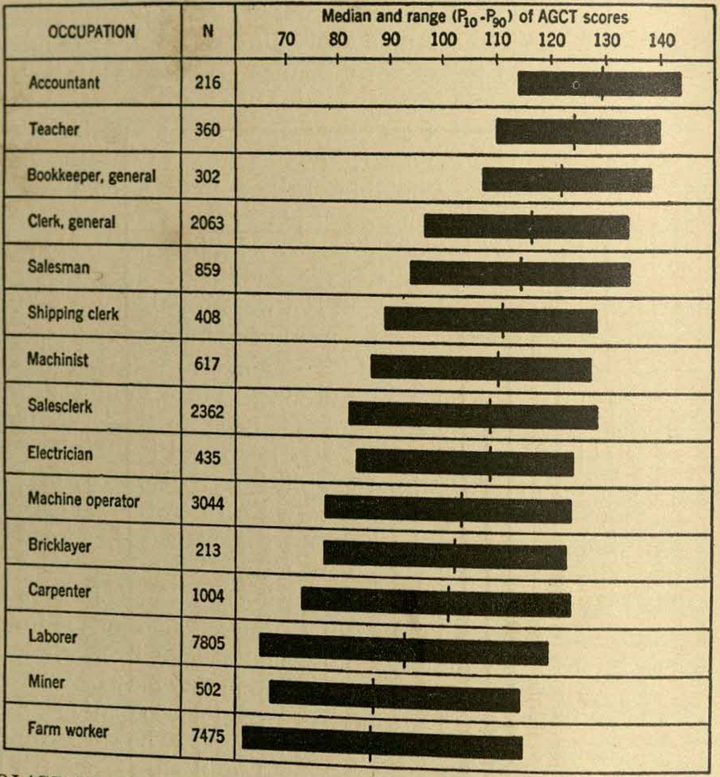

DIAGRAM 24A. TEST SCORES FOR A SERIES OF OCCUPATIONS
N is the number tested in each occupation
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high ability and modest hopes that he may well be more ambitious. Indeed, this often happens when a student succeeds in a course and consequently raises his sights, and is also a powerful argument for 'escalation' between courses (p. 115).

With such overlap between different occupations what then determines or should help to determine an individual's choice of occupation? There are the obvious facts of family upbringing, schooling and the location of industry. The son of a professional man is much more likely than average to become one also, and the school providing for such sons will strongly re-inforce this while few, if any, will be recommended to go in for a heavy industrial occupation. The social pressure towards supposed security, albeit perhaps with limited prospects, in a black-coated-white-collar job is much greater than

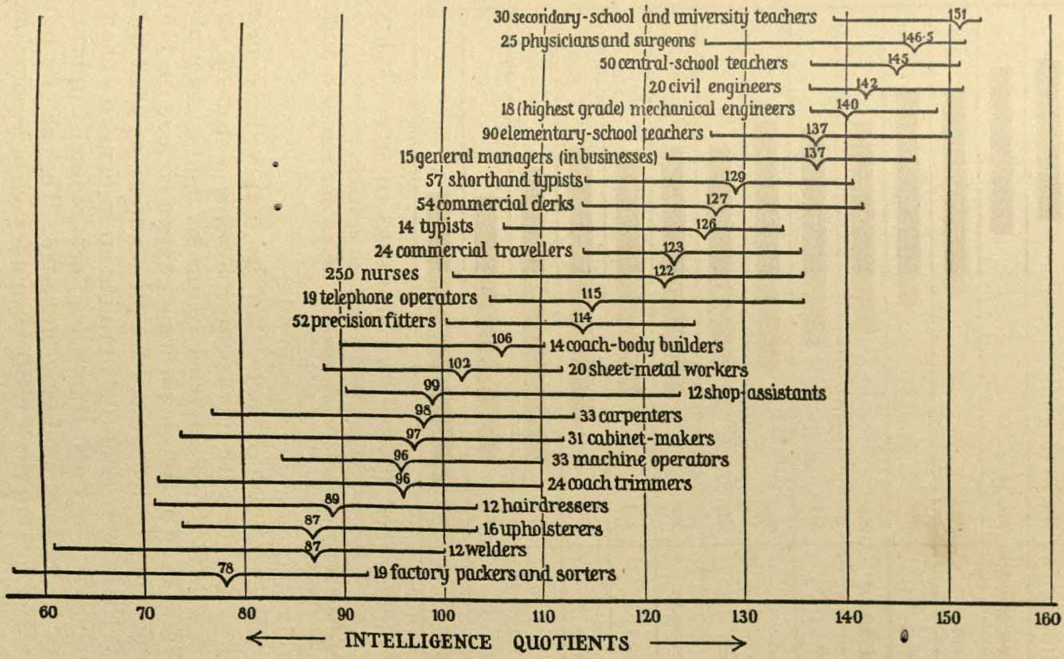

DIAGRAM 24B. INTELLIGENCE LEVELS IN VARIOUS OCCUPATIONS

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towards say, success in a foundry. Again, with similar ability, a boy or girl in Northampton is as likely to find a job in a boot and shoe factory as one will in textiles in a Lancashire town. But will this apply equally to such diverse occupations as mining, farming, shipbuilding, the chemical industry, bakery and confectionery—at what stage and to what degree do the individual's interests and special aptitudes become dominant?

By interests here is not meant the wide ranges of personal interests, inclinations and attitudes which both express and go to make up the individual's personality, and about which there is still much uncertainty and discussion [18]. Interests here connote an expressed wish to enter a given occupation and industry, or at least to be emotionally inclined towards them. Such occupational interests may derive from upbringing, from the example of favoured relatives, from chance acquaintances or from industry in the neighbourhood, through some glamorous publicity in newspapers, magazines, cinema or radio, indeed in the most haphazard way. It may derive from a realised aptitude, but also from an imagined one. The problem is to produce tests which, without being exhaustive, time-consuming and costly, will give a valid indication of occupational suitability or, what may be easier, of a definite lack of a necessary quality, e.g. manual dexterity. In addition to the pre-war development of tests of general intelligence, efforts were made to produce tests of mechanical, spatial and other abilities, and these efforts were intensified during the war in order to make the best use of manpower and reduce casualties, for example in flying duties. These wartime investigations demonstrated 'first, the value of a standard battery of group tests in a large variety of jobs, and secondly, the rather small extent to which more specialised tests helped in differentiating between different jobs. Mathematical and verbal tests tended to surpass mechanical and spatial tests even in mechanical and practical occupations. This tendency persisted when operational, as contrasted with training, criteria were studied, but would not necessarily be true under industrial—as distinct from service—conditions' [19].

This reference to the offering of the most suitable jobs to single individuals inevitably brings under consideration the work of the Youth Employment Service for this is what it mainly does. In his Address to the Conference on Human Relations in Industry, Sir George Schuster emphasised the need for more research, much of it still the empirical phase of gathering the essential facts. This is needed especially about the influences which affect the character and attitudes to work of young industrial entrants in the transition from childhood to adult employment, and which may have deep and lasting effects on human behaviour throughout the whole range of industry [20]. Professor C. A. Mace has reported on the work of the Medical Research Council's Building Research Unit in a series of articles on 'The Human Problems of the Building Industry' [21], and has urged the need for a more searching inquiry into the requirements of building education in terms of general intelligence—an enquiry probably much more urgent than the need for investigation into the requirements of so-called mechanical or spatial abilities.

Professor Mace also remarks that 'there is much to suggest that what in the past has been sought mainly through selection by test will be attained more easily through improved vocational guidance and improved training [22]. In his recommended list of researches, Sir George Schuster included the need for more knowledge about 'the transition from school to work in which the Youth Employment Service holds a key position' [23].

The Employment and Training Act of 1948 provided for the appointment of a National Youth Employment Council and Advisory Committees on Youth Employment for England and Wales. These were appointed in 1950 and subsequently presented a Report on the work of the Youth Employment Service from 1950–3 [15]. The Report is rightly much concerned with improving the Service, particularly in the training of Youth Employment Officers, with the preparation of accurate yet attractive pamphlets for boys and girls on 'The Choice of Careers Series', and closer co-operation with industry and teachers respectively. To this end also, 'Careers Notes' are prepared for officers in the Service and teachers in the schools, in continuance of those formerly issued by the Headmasters' and Headmistresses' Employment Committees. Until it was closed down the Central Office of Information Film Unit prepared six Vocational Guidance Films in the series 'Is this the job for me?' Other less expensive visual aids, such as wall charts, picture sets and film strips, are frequently used, but as the Report says 'an indiscriminate use of such media is of little value but that, when used with discretion, they prove of considerable assistance to officers, particularly in illustrating the general School Talk' [15].

The National Institute of Industrial Psychology (p. 191), has held a Vocational Guidance Conference each year for teachers and others interested in Youth Employment. It has planned Vocational Guidance Schemes put into operation at Warrington in 1947 and at Preston in 1948, with further courses of training for teachers and Youth Employment Officers of both these Local Education Authorities. A detailed report on these pilot schemes will be awaited with much interest [15]. A standard method of enquiry, known as the N.I.I.P. Seven Point Plan, collects information about the individual under the following seven headings: Physical Make-up; Attainments; General Intelligence; Special Aptitudes; Interests; Disposition; Circumstances. This framework has been found very useful as a means of organising the information which is obtained from various sources—application forms, testimonials, school reports, tests, interviews, group procedures [24].

The careers booklet of an important firm contains the following introduction:

> The choice of a career is one of the most important that our young people have to make, yet it confronts them at an age when they have little knowledge of what goes on in the workaday world and no personal experience to guide them. Obviously it is necessary to avoid a dead-end occupation which leaves its holder stranded after a few years, too old to train for a real job yet no longer wanted where he is. That, however, is negative counsel; what is needed is factual information on the real jobs that are to be had.
>
> Parents, teachers, youth employment services and appointments bureaux may help, *but only the individual employer can make clear what his particular industry has to offer.* It is clearly in everyone's interest that he should do so, for the happy worker is the good worker, and the industry that attracts those most fitted to serve in it benefits both itself and its employees [25].

The italics are not in the original but are used to single out this very understandable viewpoint and to contrast it, perhaps rather to supplement it, with a passage from the National Youth Employment Council Report [26].

> A Youth Employment Officer can be relied upon to submit the most suitable available young people for the vacancies notified to him. We hope that, as Youth Employment Officers increase their knowledge and improve their methods of working, the vocational guidance they give and the placing work they do will be increasingly acceptable to employers as a useful preliminary to their own process of selection.

The contrast between the claim of the first sentence and the *hopes* of the second is illuminating for does not the first if, properly done, wholly include the second and more? The Council then goes on to 'think that already a Youth Employment Officer can save an employer time and possibly expense by eliminating those young people who are clearly unsuitable for particular vacancies'. Does the Service save possible expense to industry at a greater expense to the taxpayer? or is it providing or hoping to provide a satisfactory selection system? Overlap may become likely between the large firm and the Service but for the most part there is more likely to be a gap in provision if these hopes are not realised. Steps towards the fulfilment of these hopes are the formation of the National Association of Youth Employment Officers and also the holding of examinations for its Vocational Guidance Diploma [27]. The technical colleges cannot be indifferent to the need or the success of the Service for many of their students are vitally concerned with it, and they are happy to be consulted where necessary by both parties. Many principals serve on the local Youth Employment Committees, but Rugby was the first to have the Youth Employment Service as part of the Technical College (p. 50).

For the technical college the dominant fact remains for most part-time day and many evening courses that industry, with or without the assistance of the Youth Employment Service, selects its recruits into multifarious occupations who then, as it were, converge on a much fewer number of courses. This then poses questions of selection and placement within the colleges during the intense period of activity known as Enrolment Week when several thousands of students are interviewed and enrolled. To ease the problems many colleges now separate the enrolment of students of previous years from the new students just entering the college. This enables the load of work to which the college is already committed to be assessed and the accommodation available for new students to be more accurately determined. Further these students 'know the ropes' and are most expeditiously enrolled; it also enables the borderline students to be given fuller consideration though it is often regretted that quite insufficient time is available for this essential purpose. No matter how great the numbers, each of these thousands of students is seen by a responsible member of staff and his record card with classwork, homework and examinations marks is available, and the borderline or difficult cases are seen by senior staff or the head of department who, in small departments, sees every student and signs the enrolment card.

As most courses are of three to five years' duration, especially part-time day, the new students form a minority of each year's total enrolment and if they are treated separately they receive much better consideration than might be supposed from the large numbers which still must be dealt with. Nevertheless, it is here that most problems and anomalies occur, where students have come to the college by a diversity of routes, at different ages and for quite different reasons, with growing or newly-stirred ambitions but often with little knowledge and less understanding of the courses they wish to take. For a regional college taking in students mostly at O.N.C. or equivalent level the problem is a relatively simple one, but for a local college recruiting all types of students into very many different courses, enrolment week is inevitably a process of selection and placement by first approximation. In the ensuing year problems come to light and are dealt with or are buried in 'the wastage' when unsatisfied, overtaxed students, or those of weak determination and fast-waning interest no longer attend and do not respond to the attempts to recall them.

This 'wastage' or loss of students throughout a whole course of several years is a topic of almost perennial discussion but certain points still need to be made clear. The first is the need to distinguish the effect of the educational or examination selection from the much more arbitrary background factors which impinge on part-time students, especially evening students more than any other group of students. Setting aside these factors for the time being, let us examine the cumulative effect of successive years of examinations, for example in an Ordinary and Higher National Certificate Course, as shown in Diagram 25.

Suppose we have 100 students entering S.1, as shown in (A) of Diagram 25, on completion of secondary education to 16 years of age, or to 15 years plus one year in the Preliminary Senior Technical (P.S.T.) Course or on other equivalent grounds. Suppose further that 50% pass into the following S.2 year, and again into S.3 and then 50% gain Ordinary National Certificate. Thirteen students out of the original 100 would thus succeed in gaining the first qualification without repeating at any stage. Not all the 100 finish the first year and sit the first year examination, and those who fall by the wayside are indicated by the shaded portion of the S.1 year. If 25%thus leave early, the 50% pass of those entering the course becomes 66% pass of those actually sitting the S.1 examination, which is certainly high. There is pre-examination wastage in the S.2 and S.3 years, but to a much less

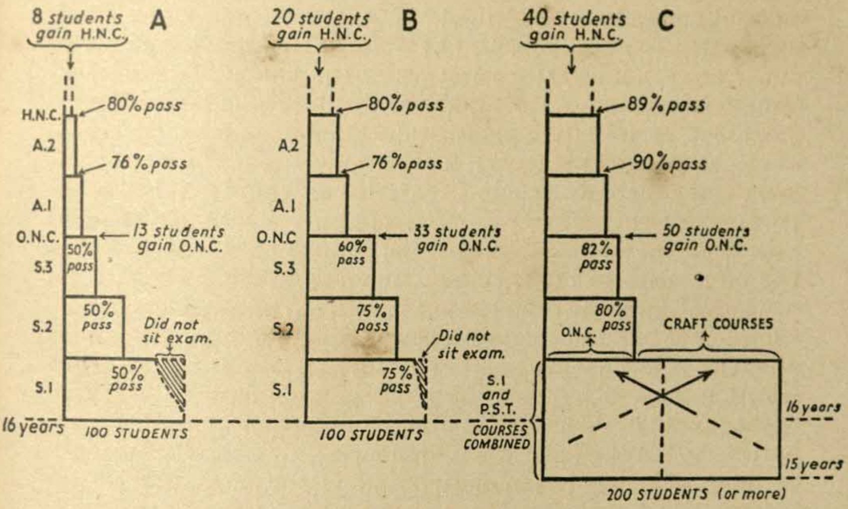

DIAGRAM 25.

SELECTION AND PROGRESS IN NATIONAL CERTIFICATE COURSES

extent, and it should be noted that this diagram does not include those who enter direct into S.2 with exemptions from S.1 with G.C.E. Certificate. It is common experience that the pass ratios for H.N.C. Courses are higher, and with successive rates of 76% and 80% the final result would be that eight students would gain H.N.C. in the minimum time of five years from intake at S.1. A supposed pass figure of 13 students gaining O.N.C. at the first attempt is certainly not too low; on the contrary research in progress [11] indicates it is too high, for of 241 students entering S.1 in four colleges only 16 completed O.N.C. in the minimum time, i.e. 6·7% or about seven students out of an original 100.

Let us now suppose that the original intake at S.1 was much more carefully selected (deferring consideration for the moment as to what this would mean in practice) so that more homogeneous classes of more promising students were possible from the start. This would avoid the principal teaching problem of too wide a spread of ability in a class, which seemingly ought to be avoided or minimised with four sets of 25 students; but how often is resorting done or possible with groups attending college on different days of the week? There would tend to be much less wastage through the year, and we should then expect a higher rate of pass at each stage with perhaps a sequence as shown in (B) of Diagram 25. If this obtained, 33 students might gain O.N.C. (compared with

13) and 20 students might gain H.N.C. (as compared with 8). While the 100 students in (A) may be selected from a not much larger group, the selection of the 100 students in (B) implies a much greater number of rejects and, therefore, a much larger initial population to choose from. Thus, for example, the 13 O.N.C. and 8 H.N.C. results under (A) might have come from an initial population of 130, that of the 33 O.N.C. and 20 H.N.C. from a population catchment of 200. This would be an increase in overall percentage pass for H.N.C. from 6 to 10% and O.N.C. from 10 to 16%.

The crux of the matter is what additional means of selection, or of increasing the efficiency of selection, must be applied to give the better intake under (B). The short answer is that we do not know. The concern about wastage is the reason for beginning schemes to coalesce the P.S.T. and S.1 years, and for using the two-year period as one of selection through training as shown in (C) of Diagram 25. To the original 100 S.1 entrants have been added 100 crafts students (arbitrarily, for it might well be 200). And at the end of the two-year period it is supposed, for purposes of comparison, that the same number of 75 students will pass into S.2 as in (B). This group will presumably be better selected and at best attain a sequence as shown in (C), gaining 50 O.N.Cs. and 40 H.N.Cs. The extremely high pass ratios of 90% and 89% at A.1 and A.2, i.e. 80% for the H.N.C. course on intake, should be compared with the London School of Economics of 76% before the research and about 85% afterwards (p. 220). This system would also presumably ensure that a larger number of students would proceed to craft courses.

The fivefold increase in production of H.N.Cs. and fourfold of O.N.Cs. which this portrays would be most gratifying—if we could answer some very awkward questions. Supposing all other factors to be favourable, the first critical question is just how many potential H.N.Cs. and O.N.Cs. are there in the original intake. Is it 40 per 200 of the students we receive, instead of the 8% or the 7% shown by the research in progress? Are we really losing so many due to the operations of adverse factors already referred to? If so, is it not high time something was done to remedy this waste of ability? It should be noted that 8% under (A) is supplemented by those who eventually pass after repeating a year or two on the way and the same is true of 13% of O.N.C. What then can or should be done to ensure that they arrive on time? Suppose this involves a reorganisation as in (C), or a still more elaborate selection scheme of additional tests impossible to apply in enrolment week, and difficult to apply widely even in the first year, a series of tests costly to prepare and needing re-validation at frequent intervals—suppose all this, is it really worthwhile if to 8 H.N.Cs. in (A) another 8 students qualify a year later in the ordinary way of one repeated course? The total of (A) would then compare with (B) but not with (C), which, if it were the valid total, would certainly justify a lot more care in selection.

In (C), 75 students out of 200 are shown as being selected for O.N.C. of whom 50 qualify, i.e. 25% of the original 200; of these 40 gain H.N.C., i.e. 20% of the original 200. If these are too high a proportion of students already pre-selected by industry, what should the proportion be? and further, what total numbers does industry need at O.N.C. and H.N.C. levels? Directly related to this is the question of what we can do about easing the adverse background factors which so materially reduce students' performances in these courses [28]. The simplest answer for the ablest is to reduce the stress and strain by transferring them to sandwich courses (p. 86), or, for degree and A.R.I.C. students, etc., to transfer them into full-time courses at a significant stage. This solves one problem by creating another, indeed several; for at what level can we select, for example, potential Higher Diploma students from O.N.C. courses—shall it be at S.2 or S.3—and on what criteria? And by 'potential' here we mean those who will stand a high chance of succeeding, 80 to 90% perhaps. Moreover the potential degree of success and the criteria laid down must readily satisfy the Ministry, and the Local Education Authorities for the award of scholarships and grants (p. 525). Again the answer is that research is most urgently needed, research which is far more than an empirical tabulation of practice to date.

At the national level there is too the major question of the total potential of ability in the population capable of undertaking successful professional and degree-equivalent courses (p. 462) [29]. Yet another awkward question is whether industry really wants the more efficient selection as envisaged in (C), for this would strip the craft courses of all the higher level of ability? Will these be the kind of future craftsmen that industry has in mind? What is the minimum level of general ability required for the attainment of first-class craftsmanship?

On the problem of selection Professor C. A. Mace has stressed the following principles 'i. There is no *one best method* which used in isolation will do what we require. . . . ii. No single method, and no combination of methods, has

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On the problem of selection Professor C. A. Mace has stressed the following principles 'i. There is no *one best method* which used in isolation will do what we require. . . . ii. No single method, and no combination of methods, has yet attained finality. iii. There is no *once-for-all* procedure that will do the trick. Selection and educational guidance are progressive procedures. Mistakes are made, latent talents emerge. Provision must be made for correcting mistakes and for giving scope for emergent interests and bents. iv. The merits of any selection system must always be judged by comparison with available alternatives'. In technical education there is certainly urgent need for a closer examination of methods of selection and placement of students, singly and in combination. Present indications point in the direction of applying several methods over a period of time, which means that the 'selection must be "built-in" to the teaching-training process. . . . The initial selection procedure must be simple, brief, administratively convenient *and provisional*; and the first stage in teaching should be so organised as to complete or at least continue the process of selection and placement.' One move in this direction is the introduction of proposed new schemes for treating the pre-S.1 and the S.1 (first year) O.N.C. jointly as a period of selection through training of students into O.N.C. and craft courses respectively (Diagram 25). During this initial provisional or probationary period there would also be excellent opportunities for 'counselling' students and thus helping them with their personal as well as their vocational problems (p. 517).

One important matter is the significance of ancillary subjects in selection for the main line of study or training. For example, to what extent should success in mathematics be a determinant in selecting promising engineers or craftsmen, or success in physics in selecting chemists (p. 429). With the recent increase in the number and range of ancillary subjects being demanded of students at all levels, this will become an increasingly urgent problem, and we know very little about it.

Finally, there is one issue to which we come back repeatedly in practice, that in the more elementary courses and classes especially, we are trying to remove a continuing cause of wastage which should not be with us—the lack of a good general education at school. And who expects it to be otherwise with so many in such large classes at such a formative stage? This is the most foolish of economies, with an inescapable continuing cost in the diminished potentialities of the individual, and cumulatively in the general good of the nation. Nevertheless, if all were well in this respect, problems of selection and placement would remain and the need for research and counselling would still require far more staffing and general support than is now unfortunately the case.

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CHAPTER VIII

ENGINEERING

By C. L. OLD, B.Sc.(Eng.), M.Sc.Tech., M.Inst.C.E., M.I.Mech.E.

Introduction and Historical Survey

Engineering is the activity of man by which he seeks to control and direct the resources of nature to his own use and benefit. Taken on this broad basis it constitutes one of the main endeavours of man and is quite distinct from his other activities such as his achievements in politics and government, in artistic expression or his religious aspirations and his reaching out to the unknown. It traces its beginnings almost to the dawn of human existence on this planet and would embrace the craft of the prehistoric hunter and his primitive attempts to make and use weapons. It would cover the endeavours of man to master the materials available from the Stone Age and Eotechnic Era onwards (p. 38).

The Ancients who come within recorded history have some very considerable engineering works to their credit. Many can still be seen in whole or in part, such as the pyramids of the Egyptians, the magnificent temples and public buildings of the Assyrians, of the Greeks and the Romans, the irrigation systems and aqueducts of the Egyptians and Romans and the remarkable roadways, still the basis of some of our English roads to-day after 2,000 years have passed.

Throughout this long period of development, science, which is the understanding of basic principles, played but a small part. Knowledge, largely gained from experience, was passed from generation to generation, mainly through a priestly caste, as a body of known and established fact. The Greeks who were some of the earliest experimenters with ideas and theories did not, in general, co-ordinate ideas with practice. The Egyptians may be considered to have done so in their surveyings of land, but it might be argued that the use of mathematics in this connection was no more than a technique.

It was not until the fall of Constantinople in 1453 and the revival of learning that followed it, that men's minds began to appreciate the importance of a knowledge of natural laws in supplementing the techniques and skills already developed. Not that the idea was new, for Vitruvius, the Roman architect who lived during the first century B.C., had said that 'only those who have mastered theory and practice are fully equipped to achieve their task with honour'; but a general acceptance and implementation of the idea had to wait until the period of the renaissance, and it was left to Francis Bacon in about 1600 to give expression to the definition embodied in the opening sentence of this chapter.

It required the passage of several centuries for this general idea to gain sufficient acceptance for the universities to open their doors to applied scientists and engineers, and even now there is a reluctance in some quarters to accept these studies as being equal in status to some which gained entry to medieval universities.

Although modern engineering still accepts Bacon's dictum as its *raison d'etre* it is confined to certain well defined fields, and few modern engineers are knowledgeable in more than one or two of these. Demarcation of the fields is emphasised by each being covered by a group of practitioners educated and trained as specialists so that to-day an engineer may be classified as civil, mechanical, electrical, production, municipal, aeronautical, radio and so on. Nevertheless, there is a general body of principles, practices and attitudes which marks engineers from those who follow other professions, although some may not be exclusively applicable to engineering.

Engineering as an Art as well as a Science

Lord Dudley Gordon, in his Presidential Address to the Institution of Mechanical Engineers in 1947 [1], gave the following description of engineering:

> Engineering is the great constructive profession, which benefits the world by things made and done, and not merely talked about. The great steps in its progress have been taken by exceptional men who, by 'drawing correct conclusions from insufficient premises'—in other words by guessing wisely—and then daring to risk their reputations and their fortunes in putting their ideas to the test, have achieved results afterwards to be explained in detail by the theorists. They used, of course, all the scientific knowledge they possessed, much or little, but their unformulated wisdom known as intuition, and above all their enterprise in using it, was most frequently the cause of their success. Deplorable as it may seem to the academic mind, it has to be admitted that industrial practice has often run well ahead of theory. Water-wheels, for example, were in use centuries before there was any formal theory of hydraulics; the steam engine was brought to a very high degree of perfection more than a generation before there was any science

of thermodynamics; steel was hardened for ages before metallurgists could give a proper explanation of it, and we should, indeed, never have had any science of metallurgy at all if steel and iron had not previously been made. . . .

This definition makes it clear that engineering is much more than a science. It is, in addition, an art in which judgements, based on knowledge and experience, are bound to play a vital part (p. 448), as T. R. Cave-Brown-Cave knew when, in his Presidential Address to the Engineering Section of the British Association in 1948 [2], he said:

> An engineer must have a good appreciation of the degree of accuracy which is necessary in his work. Insufficient accuracy may lead to wrong and dangerous conclusions; excessive accuracy causes waste and delay.

There is another sense in which engineering is as much an art as it is a science, and that is in the field of human relations. Few engineers work in isolation, and those who do are 'calculators' rather than engineers. Almost always, engineering works are carried out by a team, so that the industrial engineer sooner or later finds himself in a position involving relationships with his seniors, equals and subordinates. In few professions are human relations so important in determining the quality and quantity of work performed.

Training

Engineering, as we now understand it, is of comparatively recent date, and every engineer must undergo considerable practical training as well as receive instruction in underlying principles and the two must be intimately intermixed. From the practical point of view, engineering may be divided into two main groups. In the first, the young engineer receives his practical training in hand and machine skills and during his apprenticeship 'serves his time' in a workshop. His subsequent career will presumably be spent in those branches of engineering which cover design and manufacture or maintenance of machines or machine-made products.

In the other group the young engineer 'serves his time' in an engineer's office and concerns himself from the start with the organisation of the movement of large quantities of materials such as earth, water, concrete and steel. In this case, the human agencies employed are not usually skilled, as in the first group, but consist of gangs of manual labourers supplemented with the craft skills more properly associated with the building and constructional industries and by machines.

Branches of Engineering

In the first group fall such sub-divisions as mechanical, electrical, production, radio, marine, aeronautical and, perhaps, chemical engineering. In the second group fall civil, municipal, structural and water engineering, but here some knowledge of basic mechanical engineering is necessary because all branches use machines to a greater or lesser degree.

Mechanical engineering is concerned with the design, operation and maintenance of machinery, and arose out of civil engineering with the emergence of the rotative steam engine, the work of Boulton and Watt in 1782; electrical engineering covers a similar field in electrical machinery plus electrical power generation and transmission.

Civil engineering, the first of the technologies, deals with major constructional works such as dams, canals, railways and harbours and includes structural engineering (concerned with the design and construction of bridges), municipal and water engineering. Aeronautical engineering is concerned with all aspects of aeroplane design, manufacture, operation and maintenance. Three branches of engineering are dealt with in other chapters; chemical engineering as the fourth but rather different primary technology, and marine engineering, as exemplifying special conditions are both in Chapter XIII; structural engineering, which is so closely allied to building is dealt with in Chapter IX.

Men of like trade and occupation have always tended to form groups and associations and to transmit to succeeding generations their knowledge of principles, techniques and skills. The first important banding together was in the guilds of medieval craftsmen which accepted the training of apprentices as a major responsibility. Under the guild system the master craftsman accepted complete responsibility for the apprentice, including feeding and clothing him and even his moral welfare. Indeed, for all practical purposes, the apprentice was a member of the master's household.

College Contribution

The Industrial Revolution rendered this form of training—particularly for what we now know as mechanical engineering—obsolete, because the new industry required the combined efforts of large numbers of people, and the utilisation of the power made available by steam. And so, the factory system developed and with it an increased need of education. New scientific laws were being enunciated, and many had a direct bearing on industrial processes so that it became necessary for an apprentice to be given some instruction in underlying principles in addition to his practical training acquired by working alongside skilled men. The need was primarily for technical education in an industrialised society but this could not be built except on a foundation of general education, particularly in reading, writing and arithmetic. The latter half of the nineteenth century saw the shaping of our modern educational system, and considerable impetus was given to the movement by the exhibitions of 1851 in this country and 1867 in Paris. The pattern of practical training during the day, and theoretical instruction in the evenings, was laid down, and with very important modifications in recent years is still with us.

Works Training of Apprentices

A new phase started as a result of the second world war and the 1944 Education Act. The large demand for highly trained persons to initiate and develop new devices and indeed exploit new ideas, brought a realisation to the nation of its dependence on the skill of hand and brain of its industrial workers. It increased the demand for technical education and training and underlined the need for intensive co-operation between those responsible for practical and theoretical aspects of training. This, together with the shortage of young men of the right calibre, has led to a new approach by many firms and the nationalised industries to the recruiting and training of apprentices (Chapter VI) [3].

Of the larger private companies many recruit their apprentices at two levels corresponding, in general, to the two streams leaving grammar and public schools on the one hand, and the modern schools on the other. To the former, assuming an adequate General Certificate of Education (G.C.E.), they offer an all round training in engineering works practice, and to the latter, more specialised training in a particular craft. To both grades an essential element of the scheme of training is that apprentices are released on one day per week to attend part-time courses of study at the technical college.

Works training of apprentices is frequently organised in an apprentices' school, the object of which is well indicated by the following paragraphs from the brochure of a large engineering firm in the Midlands [4].

A progressive organisation such as ours needs a constant flow of new entrants, not only to fill the ever growing ranks of work people, but also to provide the technicians and leaders of the future.

The object of the training school is to direct youthful ambition and talent along realistic lines to their proper fulfilment by giving every new entrant an opportunity to progress as far as his aptitude will take him.

In very many cases the apprentice school has its own training workshop in which the apprentice spends a period varying from six months to three years before entering the production shops of the company. By this means he is taught the hand and machine skills of his trade in an intensive way and under the full-time guidance of his instructor. Under the older system of apprenticeship, the apprentice was left to pick up what he could from working alongside and assisting a skilled man. But the skilled man was mainly concerned to earn the highest wages available to him, so that the amount learnt and degree of skill acquired by the apprentice depended on the chance that the man with whom he worked had a sympathetic understanding of his problems and on his own natural aptitude to 'pick up the trade'.

The type of work performed by the apprentices will depend upon the outlook of the chief instructor. On the one hand, he may be introduced to production work of a kind considered suitable for training within the apprentices' shop or he may be put through a series of routine exercises. Probably the ideal scheme is one whereby a very few routine exercises are followed by the making of certain hand tools for the apprentices' own kit, the sequence being arranged to introduce him to various operations at appropriate stages. After the training shop the apprentice will go to the production shops where he will see and practise the skills he has learned, and also develop still further that valuable adjunct of works training, his knowledge of and skill in human relations.

Although the basic training in the training shop is usually common to all types of apprentices, there will be differences when they enter the production shops; the route taken will depend more on scholastic attainment, both at entry to the training scheme and subsequently, than upon ability shown in the training shop, although both are important.

Craft Apprentice

For the boy of normal ability with a modern school background, the future may well be through a craft apprenticeship, chosen from the following, although the list is by no means complete: Fitter, turner and machinist, pattern-maker, moulder, tool-maker, millwright, instrument-maker, electrician or sheet metalworker.

Concurrently with the practical training received in the works, the apprentice would follow a course at the local college for the appropriate City and Guilds craft certificate. With good ability and with sound advice from his apprentice supervisor, he will take advantage of a comprehensive course including mathematics and drawing in addition to the craft subject, so that, if he is successful in passing the examinations, he will qualify for a Full Technological Certificate of the City and Guilds of London Institute. The first class pass is indeed a qualification of which he may be proud.

The future of the craft apprentice—assuming he is a good craftsman and is successful in his course of study—may be as chargehand, assistant foreman, foreman, and if he prove to be outstanding, he may well progress to departmental manager.

Engineering Apprentice

For the boy who is above average from the modern school, or who holds a General Certificate of Education or other suitable qualification obtained at a grammar school or technical school, the course through the production shops may be more general under an 'Engineering Apprenticeship'. His aim is probably the drawing or design office [12], and if able enough, he may be given opportunities to rise to top management. For these purposes it is more important that the apprentices should obtain a tolerable skill and knowledge of a wider range of crafts, through spending periods of from one to four months working in each of the following trades: fitting, erecting, machine shop, pattern shop, foundry and forge, and during the last six or twelve months spending periods in the planning office, and, finally, the drawing office. If the apprentice intends to gain experience in the sales side of the business, he might have a period in the costs office. The engineering apprentice will need to follow a course of study equally with his craft apprentice colleague, but for him it will be rather more mathematical and scientific in content. He will almost certainly follow a National Certificate course in mechanical, electrical or production engineering, and ultimately aspire to corporate membership of one of the engineering learned societies or institutions (p. 157).

Graduate or College Apprentice

A third type of apprentice, catered for particularly in the larger engineering firms, is known as the graduate apprentice. He has a relatively short period of works training, usually no more than two years. He will most likely follow a similar course to that of the engineering apprentice, but his object will be to gain a knowledge of the potentialities of processes and skills rather than to acquire them himself. His educational background, whether university or major technical college, should fit him to occupy any position of a technical or managerial nature to which he may aspire, always assuming, of course, that he possesses those all important qualities of personality and character which, in the long run, prove to be at least as important as technical and scientific qualifications.

Although the foregoing may suggest three quite different systems of training, they are, in fact such that an able apprentice may readily step from one to the other. Indeed, one of the merits of the present system of apprentice training as practised in the larger firms with their own full-time apprentice supervisors is that personal attention is possible for each apprentice, and he may therefore be given a course which develops his natural ability and potentialities to the full.

The modern counterpart of the medieval Guild Apprentice Master frequently goes as far as his predecessor and provides first-class hostel accommodation and ample facilities for social intercourse. Thus are the advantages of 'residence' made available to the engineering apprentice who is also a student of a technical college. Further, the entire practical training of the apprentice and his progress through his course of study is the responsibility not of a nebulous 'employer' or 'firm' or 'company', but of an apprentice training committee whose chairman may well be of director rank in the company with responsibility for research and training.

The large industrial company has been taken as the example of apprentice training and, quite obviously, the large and wealthy firm is the one that is able to attract the best boys and offer the best facilities. However, most firms employ 500 employees or less (p. 200), with correspondingly small numbers of apprentices. In the workshops of these firms no special apprentice training shops are available, but many send their juniors to the local technical college on one day per week, and take a very keen interest in college reports probably through a part-time apprentice supervisor.

There is ample scope for any type of boy who has a practical bent, and his ultimate success does not depend so much upon his ability as a scholar, but rather on his ability to adjust himself to the modern world with its emphasis on a knowledge and skill in the manipulation of materials, machines, processes, and in dealing with people, along with an overriding recognition of economic realities.

Specialisation

Engineering, like most professions practised to-day, is made up of specialisations so that although, in the early stages of practice after qualifying a young engineer may be capable of turning his attention to almost any branch, he soon finds that he will be classified as 'Civil', 'Mechanical', 'Electrical', 'Mining', 'Production', 'Structural' or one other of the numerous branches. Indeed, it is highly probable that he may have decided at the school-leaving stage which kind of engineer he intends to become, and if his practical training proceeds concurrently with his studies his specialisation will begin early.

Range of Courses in Technical Colleges

Engineering is still the largest single interest in colleges and the range is from solely evening courses for craft certificates right across the academic scale to full-time University and Higher Diploma courses. From the point of view of organisation within a technical college, the work falls into three broad groups which may be classified as university, professional and craft.

University Degrees

Courses for university degrees are held in 54 colleges, but a few colleges are able to prepare students for London Internal Degrees, particularly certain of the London Polytechnics (Appendix, p. 610). In a small number of major institutions the facilities are ample and compare favourably with university provision. Any college aspiring to London Degrees in engineering must be inspected, for the university is concerned to see that standards of instruction and experience in laboratories outside its own walls shall not fall below those set within its own colleges (p. 160). This insistence on adequate laboratory work emphasises one of the characteristics of training in engineering, because, in addition to having some craft ability or at least some acquaintance with craft techniques, an engineer must be prepared to submit his ideas to experimental verification. There is still an element of empiricism in the science of engineering, the facts of which can be verified only by an experimental approach.

Regulations governing External Degrees are published by London University and varied from time to time. The main elements of these are that candidates must first qualify through a General Certificate of Education at Advanced Level, or an Intermediate Science qualification, after which the degree examination is taken in three parts normally spread over three years of full-time study. The examination is conducted in four branches: Civil, Mechanical, Electrical and Aeronautical Engineering.

Part I is common to all branches and comprises the basic engineering subjects of Mathematics, Materials and Structures, Mechanics of Machines, Engineering Drawing, Mechanics of Fluids, Applied Heat and Applied Electricity.

At Part II six subjects are required from all candidates of which Mathematics is compulsory, four are compulsory according to the branch and one is selected from a limited list, again depending upon the branch.

In Part III, five subjects are required, three according to the branch and two of Part II standard selected from a short list or they may be more specialised aspects of the compulsory subjects at Part III.

The three compulsory subjects are as follows:

CIVIL ENGINEERING

Theory of Structures
Geology and Soil Mechanics
Mechanics of Fluids and Surveying

MECHANICAL ENGINEERING

Strength of Materials
Mechanics of Machines
Applied Thermodynamics

ELECTRICAL ENGINEERING (3 only)

Electrical Theory and Measurements
Electrical Power and Machines
Electronics
Telecommunications

AERONAUTICAL ENGINEERING

Aircraft Structures
Aerodynamics
Mechanics of Flight

For most of the subjects at all levels laboratory work is required and, hence, the universities' insistence on adequate standards of equipment and staffing in the colleges.

The external degree denotes a high standard of academic attainment and, if it is obtained on the basis of a part-time course the student must have a strong character and will to persist; he will also have gained valuable practical experience concurrently with his course of study.

National Certificates and Diplomas

The 'Mechanical' National, the first examinations for which were held in 1922 with 1,125 students from 50 colleges, was not only the prototype of National Certificate schemes, but has proved numerically to be the most successful. From the students' point of view, it marked a great step forward in that he was able to follow a co-ordinated course of study, backed by a great professional body which would recognise his studies as satisfying certain requirements for membership. Indeed, the National Certificate Scheme has been the means whereby many thousands of engineering apprentices have ultimately gained professional status.

There are at present in the engineering group, Ordinary National Certificate schemes in Mechanical and Electrical Engineering, and Higher National Certificate schemes in Mechanical, Electrical, Civil and Production Engineering with counter signature arrangements of Mechanical certificates by representatives of other bodies (p. 156). The present number of awards is given in Table 23 (p. 155), and their development over the years is shown in Diagram 26A for England and Wales, and in Diagram 26B for Scotland.

National Certificates in Mechanical Engineering—Ordinary National Certificate

The general plan of National Certificates in Mechanical Engineering is set out in *Rules for Guidance 106* (Appendix, p. 621). Within the framework of the Rules a college is at liberty to offer the subjects of its choice and to develop its own syllabuses with the advice of the local and specialist H.M. Inspectors. Although National Certificates stand in their own rights, they may be designed to gain recognition by the Institution of Mechanical Engineers as exempting from some part of their Associate membership requirements (p. 157).

The Ordinary National Certificate courses in engineering follow the usual pattern described in Chapter IV (p. 113), and Chapter V (p. 154). With regard to entry standards the pattern is changing somewhat in that, for those young people released from employment, a preliminary course may be available during the day in either a local or branch technical college, and this is preferable to one year at an evening institute.

For a holder of a General Certificate of Education at

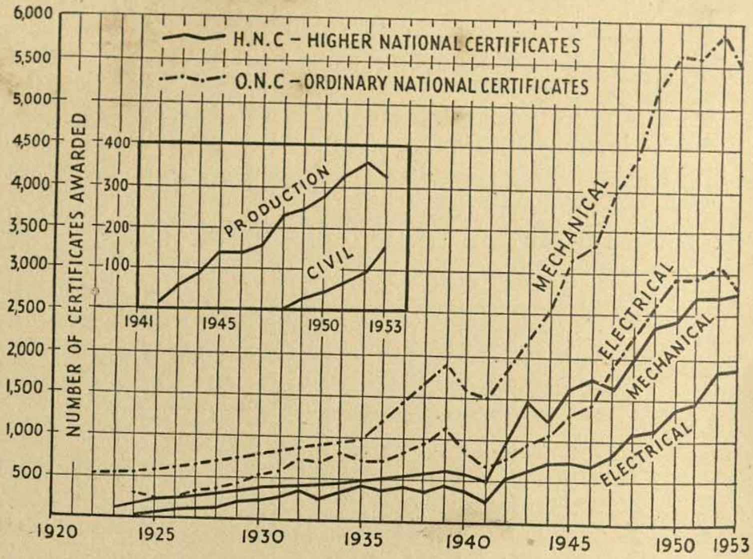

DIAGRAM 26A. INCREASE IN AWARDS OF NATIONAL CERTIFICATES IN ENGINEERING (England and Wales)

Sources: Secretaries of the Professional Institutions

Ordinary level with at least four subjects, two of which must be mathematics and a science, entry may sometimes be gained to the second year of the course, providing a qualifying examination in engineering drawing is taken. If the relationship between the technical college and the secondary technical school is right, it should be possible to work out an arrangement whereby the fundamentals of the first year of the Ordinary National Certificate course are covered at the school, thereby admitting the ex-pupil to the second year alongside the G.C.E. holder. These ex-pupils of secondary technical schools are among the best who enter technical colleges because their general education has been designed to include an introduction to those subjects required in their chosen vocations.

The preliminary year of the evening institute or equivalent is aimed at providing a basic and consolidating course for the modern school leaver. Here is a serious gap in our present educational system, that no recognised examination at 15 years links the schools and the technical colleges. While there is no positive link between the large proportion of grammar school pupils who do not proceed to the university

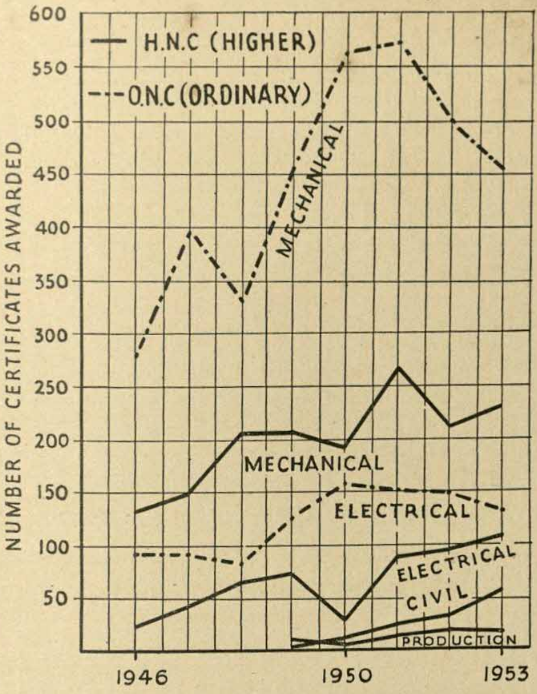

DIAGRAM 26B. POST-WAR INCREASE IN AWARDS OF NATIONAL CERTIFICATES IN ENGINEERING
(Scotland)

Source: Scottish Education Department

and the technical college for degree or diploma courses, at least, the General Certificate of Education provides a standard recognisable by both school and college. At present the modern schools are alone in not having some form of linkage with institutions of further education although they have about 70% of the nation's children. The link may come for example with such new developments as that of the School Leaving Certificate of the Union of Lancashire and Cheshire Institutes.

The usual elements in the preliminary course, which is based on a three evenings per week attendance, are mathematics, technical science, drawing and English, and if a day-release scheme is available, some civics, current affairs, or physical education may be added. Successful completion of the preliminary year will give admittance to the first year of the

National Certificate course or, if the success is only partial, the student may be recommended to follow a City and Guilds' craft course.

The first and second years of the National Certificate course invariably consist of engineering science, mathematics and drawing. The science syllabus is mainly mechanics, to which is added an introduction to heat and hydrostatics. Drawing is not carried beyond the second year, and so is not one of the 'assessed' subjects (p. 158) at the third year stage. It is sufficient for the college to certify that engineering drawing has been taken.

In the third year of the Ordinary National Certificate course, three assessed subjects are studied and mathematics and engineering science or applied mechanics appear in all schemes; the science comprises the elements of the subjects to be taken in the Higher course, such as strength and elasticity of materials, hydraulics or structures. A fair comparison may be made at this stage with the General Certificate of Education (Advanced) in which a broad approach is maintained but specialisation has begun. The third subject is generally either heat engines or workshop technology. The former includes the elements of applied thermo-dynamics and their application in both the internal combustion and the steam engine. The continued inclusion of the steam engine for all students is educationally sound, in that the working substance of such an engine is one which changes its state from gas to vapour thereby providing an important example of the application of certain principles. Heat engines is usually chosen by the student who plans to go into the drawing or design office. Workshop technology is taken by the student who expects to specialise on the manufacturing side of industry: it also covers the elements of the subjects to be developed later such as jig and tool design, machine tools, and metal working processes such as forging, welding, sheet metalwork and casting.

With more time available in day release, a student may take an endorsement subject (p. 157). This may be either heat engines or workshop technology, that is, the other alternative not taken in the course, or such additional subjects as engineering chemistry or principles of electricity. In many cases these extra subjects must be studied for two years so that it is necessary to introduce them into the course at the second year stage.

Higher National Certificate in Mechanical Engineering

The Higher National Certificate in Mechanical Engineering is taken on a grouped course of subjects, each at about pass degree standard, with three of them assessed in the final year. A much wider choice of subjects is offered to the student at the Higher level so that he may follow those most closely allied to his daily work or future interests.

Nevertheless, two subjects are of fundamental importance for mechanical engineers and, because of the relationship which National Certificate schemes bear to the examination requirements of the I.Mech.E., are almost always to be found in a Higher National Certificate scheme. These subjects are theory of machines, and strength and elasticity of materials.

These two subjects run through the two years of the course and appear as assessed subjects in the second year. They may be taken as a combined single subject in the first year, thereby making room for an additional subject. The usual pattern of Higher Certificate schemes would then include mathematics in the first year, together with the subject that will form the specialisation in the final year, thus:

Applied Thermodynamics leading to Internal Combustion Engines or Steam Engines in the second year;
Mechanics of Fluids leading to either Hydraulics or Aerodynamics.
Theory and Design of Structures which may lead to a subdivision in the second year of Civil Engineering or Aircraft Structures.

Alternatively, one of the subjects marginal to mechanical engineering, such as metallurgy or industrial chemistry, may be taken.

The young engineer will now wish to apply for membership of the Institution of Mechanical Engineers for which his National Certificates will carry certain exemptions, but some further studies are necessary to complete his qualifications for this. Before detailing the relationship between the National Certificates and professional membership, it will be well to describe the Institution of Mechanical Engineers which can be taken as typical of the three major professional engineering bodies.

The 'Institution', as it is known to all mechanical engineers, grew out of the refusal of the Institution of Civil Engineers in 1846 to admit George Stephenson to membership unless he submitted an essay to establish his competence. The early railway engineers who were his colleagues felt this demand to be an affront to the greatest railway engineer of the day and to mechanical engineering generally.

The Institution was formally founded in Birmingham in

1847 with George Stephenson as its first President, and received a Royal Charter in 1929 [5, 6]. With the Institution of Civil Engineers and the Institution of Electrical Engineers, both Chartered bodies, it shares a position of very great influence in the field of engineering, and all mechanical engineers aspire to Corporate Membership, thereby gaining the distinction of describing themselves as 'Chartered Mechanical Engineer'.

An indication of the importance of National Certificates in the growth of membership is shown by Table 38:

TABLE 38

HIGHER NATIONAL CERTIFICATE HOLDERS SUBSEQUENTLY ELECTED ASSOCIATE MEMBERS OF THE INSTITUTION OF MECHANICAL ENGINEERS (A.M.I.MECH.E.) 1945–53

Year of Election	Percentage of Associate Members with National Certificates elected (or transferred) in each year
1945	37
1946	40
1947	40·5
1948	46·5
1949	51
1950	57
1951	59
1952	62
1953	59

Present membership (all grades) of the Institution is 41,079.

The Institution has always been interested in the training of young engineers and, in 1922, established a grade of membership known as 'Student'. The grade of 'graduate' was introduced in 1850 and the conditions for admission revised to approximately their present form in 1922. Corporate Membership applies to Associate Members and Members, the latter status being conferred on an engineer only after the age of 33 and his achievement of considerable status within the profession.

For all grades of membership except 'Member' there is a recognised educational standard which can, in general, be related to National Certificates. For Studentship it is necessary, as one of the conditions, to pass the Common Preliminary Examination conducted by the Engineering Joint Examination Board (Appendix, p. 625), or to hold an equivalent School or Matriculation Certificate. For Graduateship, Parts I and II of the Institution's examinations have to be taken and for Associate Membership, Parts I, II and III.

Part I is in two sections, (*a*) being the Joint Part I examination conducted jointly by the three major institutions, the Institutions of Civil, Mechanical and Electrical Engineers, and (*b*) an additional subject prescribed by the Institution of Mechanical Engineers.

The scheme for Part I is

(*a*) English, Mathematics, Applied Mechanics, Principles of Electricity, Heat, Light and Sound, and

(*b*) Engineering Drawing.

Part II consists of four papers taken from the following list:

Group A. Two compulsory papers—Theory of Machines and Properties and Strength of Materials.

Group B. One or two papers from—Applied Thermodynamics; Mechanics of Fluids; Electrotechnology; Metallurgy; Theory of Structures.

Group C. Certain linkages with subjects in Group B may be required, but the subjects from which choice may be made are —Aeronautics, I; Aeronautics, II; Metrology and Machine Tools; Hydraulic Engineering; Internal Combustion Engineering; Steam Engineering; Automobile Engineering; Air Conditioning, Heating and Ventilating Engineering; Refrigeration Engineering; Mechanical Engineering in the Chemical Industry; Fuel and Combustion Engineering; Agricultural Engineering; Textile Engineering: Instrumentation and Automatic Controls; Mining Mechanical Engineering.

Part III is one paper in Industrial Administration.

It will be seen that certain of these subjects are similar to those of the Higher National Certificate, and indeed the possessor of the Certificate is generally exempt from the requirements of Part II on a 'subject for subject' basis. Part III is usually exempted by an endorsement on the Higher National Certificate.

The important thing to notice is the relationship which exists between the National Certificate scheme and the examination requirements of the Institution. Other conditions for the grades of membership are also laid down such as age, minimum period of works training and degree of responsibility, but these are unrelated to the National Certificate scheme.

Higher National Certificate in Production Engineering—the Ministry of Education Rules 107

The course for this certificate is very similar to that in mechanical engineering and the scheme is administered jointly by the Ministry of Education and the Institutions of Mechanical and Production Engineers. There is not yet a separate Ordinary National Certificate in Production Engineering but a Mechanical Certificate with a Production Engineering bias is the basis of entry to the Higher Certificate course.

It is customary to take the subject of workshop technology in place of heat engines in the Ordinary National Certificate in Mechanical Engineering, but schemes are in operation which are essentially production engineering courses throughout, as, for instance, one such scheme is as follows:

	Evening Course	*Day Course*
1st & 2nd Years	Mathematics	Mathematics
	Engineering Drawing	Engineering Drawing
	Applied Mechanics	Applied Mechanics
		Machine Shop Practice
		English
3rd Year	Mathematics	Mathematics
	Applied Mechanics	Applied Mechanics
	Jig and Tool Design	Jig and Tool Design
		Treatment of Metals
		English

At the end of the second year of the course, students may enter for the City and Guilds Intermediate Examination in Machine Shop Engineering. This layout emphasises the potentialities of a day release course as compared with an evening course, and the way in which a production engineering course may be compiled to emphasise those things important to the production engineering student.

At the Higher National Certificate level, a typical sequence for a day and evening course is as follows:

Evening Course	*Day Course*
1st Year (1st half of session)	
Strength of Materials	Strength of Materials
Machine Tools	Machine Tools
Mathematics	Mathematics
1st Year (2nd half of session)	
Theory of Machines	Theory of Machines
Jig and Tool Design	Jig and Tool Design
Fine Measurement	Fine Measurement
Whole session	Tool Room Practice
	English

2nd Year. Evening or Day Course

An appropriate choice of three subjects from the following, of which one must be machine tools: machine tools; metrology; jig and tool design; press and sheet metalwork; machine tool design; hot and cold forging; metallurgy; welding processes; foundry processes. If more than three subjects are taken successfully, the additional ones will be added as endorsements on the Certificate.

The final examination of the City and Guilds in Machine Shop Engineering can be taken at the end of either year of the Higher National Certificate course.

The National Certificate scheme in production engineering, like that in mechanical engineering, is closely associated with the examination standards of the appropriate institution, the Institution of Production Engineers. The Associate Membership Examination comprises Sections I, II and III. Section I covers general education and introductory engineering science and is exempted by G.C.E. (Ordinary Level) English and an Ordinary National Certificate, providing workshop technology is endorsed on the certificate. Section II, which is the main technological group, is exempted by a Higher National Certificate in Production Engineering and Section III, dealing with management type subjects, is covered by endorsements or subjects of the British Institute of Management Intermediate Examination.

The Institution of Production Engineers, founded in 1921, in 1955 has 6,660 corporate members (Members and Associate Members) and 3,480 non-corporate members (graduates and students). Its own examination requirements in force at present are as follows:

Part	*Content and Requirements* (*fundamentals*)	*Subjects*
I	Five Compulsory 3-Hour Papers	1. Workshop Technology
		2. Engineering Drawing
		3. Practical Mathematics
		4. Applied Mechanics
		5. English
II	(technological)	1. Materials and Machines
	Four 3-Hour Papers No. 1 is Compulsory Plus three Optional Papers	2. Jig and Tool Design
		3. Machine Tools
		4. Metrology
		5. Metallurgy
		6. Press and Sheet Metalwork
		7. Plastic Technology and Presswork (Plastics)
		8. Welding Processes
		9. Hot and Cold Forging
		10. Foundry Processes
		11. Applied Electricity
	(Managerial)	1. Introduction to Industrial Management
		2. Production Planning *or*
		3. Work Study

Ordinary National Certificate in Electrical Engineering—Ministry of Education Rules 127

The pattern of study is very similar to that followed by mechanical engineering students and usually both the preliminary and first years of the Ordinary National Certificate course consist of engineering science, drawing and mathematics, but the engineering science contains some reference to the principles of electrical engineering. In the second and third years a common arrangement is as follows:

	Evening Course	*Day and Evening Course*
2nd Year	Mechanical Science Electrical Science Mathematics	Mechanical Science Electrical Science Mathematics Physics
3rd Year	Electrical Technology (A.C.) Electrical Technology (D.C.) Mathematics	Electrical Technology (A.C.) Electrical Technology (D.C.) Mathematics Physics *or* Applied Mechanics

Higher National Certificate in Electrical Engineering

The grouped course leads to examinations in three assessed subjects at the end of the second year. The range of subjects from which a choice may be made is very wide, and the following is no more than a typical arrangement:

	Evening Course	*Day and Evening Course*
1st Year	Engineering Maths. Electrical Technology Electronics *or* Electrical Machines	Engineering Maths. Electrical Technology Electronics *or* Electrical Machines Applied Mechanics English
2nd Year	Engineering Maths. Electrical Technology Electronics *or* Electrical Machines	Engineering Maths. Electrical Technology Electronics *or* Electrical Machines Applied Mechanics
3rd Year	Endorsement subjects such as Instruments and Measurements Electric Power Electrical Machines Design or any 2nd year subject not previously taken.	

Candidates who obtain both Ordinary and Higher National Certificates, each with credits in two electrical subjects, may be considered for exemption from Parts I and II of the Institution of Electrical Engineers Examination, providing the courses and the final assessed examinations are recognised by the Institution for exemption purposes and that credit standard is obtained in each subject for which exemption is claimed.

The awarding of credit standard in certain National Certificates is not universally approved on the principle that National Certificate courses are based on a minimum requirement and, therefore, only a minimum condition is determinable. To award credit or distinction or any other degree of success is unrealistic because of the variation in the upper limit which is never specified. The Institution of Electrical Engineers has, however, adopted this procedure for its own examination equivalents and appears to be well satisfied with the results.

The Institution of Electrical Engineers which grew out of the Society of Telegraph Engineers founded in 1871, assumed its present title in 1888. Although it began life from an interest of its members in a narrow field of application of electricity, one of its founder members foreshadowed that 'This Society will gradually develop more into an Electrical Society than into a society of telegraphy proper; and the moment it is understood that all papers on electricity or bearing directly upon the development of electrical science are admitted, it at once takes the science out of the narrow groove into which it seems to be drifting . . . because it will be found ultimately to embrace every operation in nature' [7].

In 1921 the Institution received its Royal Charter as the representative body of Electrical Engineers in Great Britain. Its objects are, briefly, to promote the general advancement of electrical science and engineering and their applications; to facilitate the exchange of information and ideas on these subjects; to give financial assistance for the promotion of invention and research, and generally to act as a professional institution.

The total membership of the Institution in 1953, and including all grades, was 38,156, with about 40% of new members satisfying educational requirements through National Certificates.

The examination requirements of the Institution, revised by Council in April, 1953, and progressively to take effect up to April, 1956, fall into three parts. Part I is the Joint Part I with the Institutions of Civil and Mechanical Engineers to which reference has already been made.

In Part II there are four compulsory three-hour papers in: Electrical Engineering, I; Electrical Engineering, II; Mathematics and Engineering Physics; or Thermodynamics.

In Part III there are three three-hour papers: Advanced Electrical Engineering (compulsory) and *two* from the following list: Electrical Machines; Electrical Measurements; Electricity Supply; Electronic Engineering; Illumination Engineering; Line Communication; Radio Communication; Utilisation of Electric Power.

Parts I and II may be covered by exemption through National Certificates (p. 157), and Parts I, II and III by an approved degree or associateship of a college if awarded on the successful completion 'either of an industry-based sandwich course or of a full-time course.' This is bound to increase the importance of such courses as a route to professional status, and to diminish accessibility through the National Certificate route.

Higher National Certificates in Civil Engineering—Ministry of Education Rules 107

The increasing number of awards since their establishment in 1947 (Diagram 26) is an indication of the growing tendency of young civil engineers to take their training at technical colleges in properly constituted courses, rather than by private study or other means (Table 23, p. 155).

Ordinary National Certificates are not awarded in Civil Engineering but entry to a Higher Certificate course is through Ordinary Certificates in Mechanical or Electrical Engineering or Building.

The Higher Certificate course may extend over two or three years. A typical three-year course might be arranged as follows:

	1st Scheme	*2nd Scheme*
1st Year	Strength of Materials Engineering Maths. Properties of Materials	Theory and Design of Structures Practical Mathematics Engineering Materials
2nd Year	Building Construction Surveying Structures, I	Surveying and Geology Hydraulics Theory and Design of Structures
3rd Year	Structures, II Geology and Soil Mechanics Building Construction, II	Surveying and Geology Hydraulics Soil Mechanics

Additional subjects are usually available as 'endorsements' in a subsequent year.

The Institution's own examination requirements are the

Joint Part I and, in addition, either Theory of Structures or Theory of Machines.

Final Part II which completes the Institution's examinations consists of: Engineering Drawing; Engineering Materials —and three papers on one of the following groups of engineering subjects: Constructional and Public Works; Mechanical; Electrical; Structural and Building; Mining; Chemical; Shipbuilding and Marine; Gas; Aeronautical.

Exemptions are granted from both Parts I and II by certain university degrees or college diplomas, and a National Certificate or Diploma in Engineering awarded upon satisfactory completion of part-time or other courses approved for the purpose will be accepted in lieu of parts of the Institution's Examination on a 'subject for subject' basis, provided the examination papers were assessed in the final year in which the subject was studied.

The Institution of Civil Engineers, which is the premier society of its kind and the oldest in the world, was founded in 1818, and took as its province all engineering that was not military in nature. In 1828 it was granted a Royal Charter for which it was essential to define civil engineering. The definition, the first sentence of which has since become famous, was written by Threadgold, an expert in timber construction, and is as follows: 'Civil Engineering is the art of directing the great sources of power in Nature for the use and convenience of man; being that practical application of the most important principles of natural philosophy which has, in a considerable degree, realised the anticipation of Bacon, and changed the aspect and state of affairs in the whole world. The most important object in Civil Engineering is to improve the means of production and of traffic in states, both for external and internal trade. It is applied to the construction and management of roads, bridges, railroads, aqueducts, canals, river navigation, docks and storehouses, for the convenience of internal intercourse and exchange; and in the construction of ports, harbours, moles, breakwaters and light-houses; and in the navigation by artificial power for the purposes of commerce.' The Charter bestows the right on each corporate member to the description of 'Chartered Civil Engineer'.

The above definition makes clear the very large range of activities which engage the attention of the civil engineer and explains the reason that the Institution embodies so many groups of subjects as alternatives in its examination requirements.

The present membership is 20,145, and it has risen rapidly since 1948 when the figure was 16,582.

In spite of a very recently introduced National Certificate scheme (1947), 10% of Associate Members admitted in 1953 were granted exemption by recognised diplomas and National Certificates: 67% were holders of University degrees so that less than 25% were admitted by direct examination.

Municipal engineering, professionally speaking, is that part of civil engineering which may be the concern of local government. It deals with water supply, sewage disposal, highways and bridges, transport, public health services, street lighting and many other activities. Not all municipal engineers are responsible for all of the branches listed; for example, a county borough may well have a separate water department in charge of a water engineer.

National Certificate schemes have not been evolved for municipal engineers, but many technical colleges provide courses of instruction based upon the Institution's set requirements.

To gain Corporate Membership of the Institution, the candidate must be trained in a municipal engineer's office for a period of not less than three years' duration and pass the Testamur examination which consists of Intermediate and Final stages.

Subjects of the Intermediate are: Part I. Theory of Structures and Strength and Elasticity of Materials: Part II. Mechanics of Fluids: Part III. Geology: Part IV. (A) General Principles of the Theory of Machines; *or* (B) Electricity and Magnetism.

In the Final examination, candidates take a common group together with groups of subjects according to whether they are interested in municipal or county work.

General Division (for all candidates). Part I. Local Government Law, Byelaws and Administration: Part II. Sewerage: Part III. Building Construction and Quantities and Specification: Part IV. Roads and Road Construction (not taken with VIII): Part V. Town and Country Planning (not taken with VI.A.).

Municipal Division. Part VI. (A) Town and Country Planning, *or* (B) Structural Design: Part VII. (A) Public Lighting and Cleansing: *or* (B) Water Supply, *or* (C) Coast and River Protection, *or* (D) Housing, *or* (E) Sewage Disposal.

County and Highway Division. Part VIII. Roads and Road Construction: Part IX. Bridges and Culverts.

Such a course is covered by five years' part-time study at a technical college, providing an adequate standard at entry is reached such as the Preliminary Examination of the Engineering Joint Board of which the Institution of Municipal Engineers is a member. Admission to an engineer's office may be in one of three grades: (*a*) as a Pupil under Indenture, (*b*) as a Graduate Assistant under an Undertaking, (*c*) as an Engineering Learner under an Undertaking.

The Institution of Municipal Engineers which to-day has a membership of about 7,500 was founded in 1873 under the name of the Association of Municipal and Sanitary Engineers and Surveyors, and was granted a Royal Charter in 1948. Its function may be considered to date back to the period following the dissolution of the monasteries when an Act of 1555 laid it upon every parish to elect two parishioners to act as Surveyors and Orderers. Thus began the office of surveyor who discharged his duties on behalf of the community, and to-day the same idea is embodied in the Charter in expressing the first object of the Institution, namely 'The promotion of the science of engineering and cognate subjects as applied to all or any of the duties imposed upon or services undertaken by local authorities and other public undertakings for the benefit of the community with the object of securing the highest degree of efficiency in the discharge of such duties and operation of such services'.

The Institution of Water Engineers, founded in 1896, is numerically a small body specialising in a section of civil engineering and consisting of approximately 1,500 members. It does not set out any system of examinations, but its standard of educational attainment for Associate Membership is specified by requiring that a candidate shall be an Associate Member of the Institution of Civil Engineers and have passed in the subject of hydraulics. The Council may waive the Associate Membership of the Institution of Civil Engineers in favour of the Associate Membership of the Institutions of Mechanical or Electrical Engineers, but in all cases the candidate must be engaged in the technical problems or direction of gathering and/or supplying water for community purposes.

Sandwich Courses

Sandwich courses have been dealt with in principle in Chapter III, and so only those with a specifically engineering content will be referred to here. They are of growing importance as a route to professional status, and exist for students of mechanical, civil, electrical, structural, production, gas, and chemical engineering. These courses may lead to Higher National Diploma or College Associateship with full or partial exemption from the appropriate professional examinations; others in mechanical and electrical engineering lead to Ordinary National Diploma (p. 623).

Ordinary Diploma

A typical course for the Ordinary National Diploma in Mechanical Engineering is as follows:

Conditions of Admission: Either i. By special entrance examination held at the college (in June of each year) in English, mathematics and a science subject: or ii. By possession of a School Certificate with credits (or General Certificate of Education passes) in English, Mathematics and a Science subject.

Subjects:

1st Year. Applied Mathematics and Mechanical Science, Chemistry, Electrical Engineering, Science, Engineering and Geometrical Drawing, English, Mathematics, Physics, Workshop Technology and Practice.

2nd Year. Applied Mathematics and Mechanical Science, Electrical Engineering Science, Engineering Drawing, Heat Engines, Mathematics, Metallurgy, Physics, Structure of Industry, Workshop Technology and Practice.

A similar course in electrical engineering is as follows and has similar entry conditions to that in mechanical engineering.

1st Year. Mathematics, Applied Mechanics, Principles of Electricity, Heat, Light and Sound, Workshop Practice, Engineering Drawing, English and General Subjects.

2nd Year. Mathematics, Applied Mechanics, Principles of Electricity, Workshop Practice, Applied Heat, Engineering Drawing, Physics.

These two courses represent fairly standard practice in this type of diploma. It is in the Higher Diploma type of course that much greater variety is introduced.

Higher Diploma

Examples of courses extending over four years, leading to the award of Higher National Diplomas in Mechanical or Electrical Engineering by means of a sandwich course are given below. The entry conditions are that the student shall have reached at least 17 years of age, have completed at least one year in industry, and have completed satisfactorily the second year of an Ordinary National Certificate course or its equivalent.

The first two years are common to both electrical and mechanical students, and the approximate weekly time-table is as follows:

	First Year Hours	Second Year Hours
Mathematics	5	5
Physics	3	3
Chemistry	3	2
Electrical Engineering	3½	4½
Applied Mechanics	3½	3½
Applied Heat	2½	3½
Engineering Drawing	4	3
Workshop Technology	5	5
English Studies	2	2
	31½	31½

Mechanical Engineering Course:

	Third Year Hours	Fourth Year Hours
Mathematics	6	4
Strength of Materials	3	5
Theory of Machines	3	5
Hydraulics	3	–
Heat Engines	3	5
Workshop Technology	3	5
Machine Design	4	5
Electrical Engineering	3½	–
Private Study/Social Studies	3	2½
	31½	31½

Electrical Engineering Course:

	Third Year Hours	Fourth Year Hours
Mathematics	6	4
Electrical Engineering	6	–
Transmission and Distribution	–	4
Theory of Electrical Machines	–	4
Electronics	3½	4
Electrical Instruments and Measurements	3	4½
Introduction to Electrical Machine Design	3	–
Electrical Machine Design A.	–	5
Associated Electrical and Mechanical Design B.	–	4
Strength of Materials	3	–
Theory of Machines	4	–
Private Study/Social Studies*	3	2½
	31½	31½

The following three-year course in production engineering has an entry condition of Ordinary National Certificate, or a G.C.E. (Advanced) in Mathematics, Physics and Chemistry or a City and Guilds Final Certificate in Machine Shop Engineering (p. 273). This diversity of entry qualifications requires that the first year shall be a balancing year in which students follow individual courses with greater emphasis on their weaker subjects.

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*A move is being made to introduce Social Studies into such courses (p. 520).

The subjects are arranged in four groups:

1. Fundamental	2. Technical
3. Managerial	4. General

1st Year: 1. Mathematics, Applied Mechanics, Applied Physics, Electricity.
2. Industrial Processes, Production Engineering Drawing, Precision Measurement, Strength of Materials, Theory of Machines, Machine Shop Practice.
3. None.
4. Industrial History, English Usage.

2nd Year: 1. Mathematics, Applied Mechanics, Applied Electricity.
2. Metrology, I, Machine Tools, I, Jig and Fixture Design, Tool and Gauge Design, Metallurgy, I, Strength of Materials, Theory of Machines, Toolroom Practice.
3. Method Study, Industrial Psychology.
4. Structure of Industry, English Usage.

3rd Year: 1. Mathematics, Technical Dynamics, Mechanics of Cutting and Forming.
2. Metrology, II, Machine Tools, II, Machine Tool Design, Press and Sheet Metal Work, Hot and Cold Forging, Foundry Processes, Metallurgy, II, Production Research.
3. Work Study, Production Planning, Industrial Management, Cost Control.
4. None, but this is debatable (p. 520).

In each year the formal teaching periods are arranged to give time in all appropriate laboratories, and suitable industrial visits are organised.

The courses all consist of equal periods spent in the college and in industry and the majority of students are those who have already spent a period in the workshops and enter through partial or complete Ordinary National Certificates.

In the works periods—normally from March to September—the students are in every way treated as apprentices and are subject to works discipline.

In all the above Higher Diploma courses the standard achieved is that of the first degree of a university but the content is different. The courses aim to give exemption from the Associate Membership requirements of the professional bodies, and have many advantages for training an engineer who ultimately will practise his profession in an industrial concern. It is highly probable that the main future contribution of technical colleges to technological education will be in the sandwich type of course, and at this level only those courses which are of sufficiently high standard are desirable.

City and Guilds Courses

The third large grouping of work performed in the engineering departments of technical colleges is that concerned with City and Guilds of London Institute syllabuses and examinations. The system has already been described (p. 113), so that only a few of those courses important to engineering will be dealt with here. The large volume of such work is shown by the 1953 figures:

Subject	Entries	No. Sat	Passed
Telecommunications Engineering	30,514	26,108	16,473
Machine Shop Engineering	4,724	4,613	2,347
Automobile Engineering Practice	2,527	2,453	1,195
Electrical Installations	2,041	1,989	924
Radio Service and Radio Service Certificate	1,091	1,068	482
Sheet Metal Work	932	889	605

Machine Shop Engineering

The course is designed to provide training in the manual skills associated with metal machining operations and a knowledge of the related scientific principles.

It is a basic assumption of the course that the student is engaged upon machine shop work at his place of employment where the main part of his skill is acquired. The content of the course is approved by the Institution of Production Engineers and exempts from part of their examination requirements.

There are two stages—Intermediate and Final—the whole covering four or five years. The course comprises workshop technique, science, calculations and drawing, and a scheme of practical work at both Intermediate and Final levels. The principal of the college must certify that at least four of the sections of practical work marked i.–viii. below for the Intermediate, and at least two marked ix.–xvii. for the Final, have been carried out either at the college or in the works. Outline syllabuses are as follows:

Intermediate. Workshop Technique—materials, machine tools and machining, cutting tools, bench work, measurement and gauging, safety measures.

Science, Calculations and Drawing—heat, mechanics, arithmetic, mensuration, geometry, trigonometry, three dimensional drawings of simple machine parts.

Final. Workshop Technique—materials, machine tools and machining, cutting tools, jigs and fixtures, measurements and gauging and one or two of the following sections: (A) Turning, including vertical and horizontal boring; (B) Tool setting; (C) General machining; (D) Fitting and millwrighting; (E) Toolmaking.

SCHEME OF PRACTICAL WORK

Intermediate. i. Marking out; ii. Fitting and bench work; iii. Tool grinding; iv. Turning; v. Milling; vi. Shaping; vii. Grinding; viii. Heat treatment.

Final. ix. Marking off, setting up and machining in a lathe; x. Planning and setting up of turret or capstan lathe; xi. Machining to limits; xii. Machining on a universal miller; xiii. Grinding including parallel and taper work; xiv. Machining operation requiring planing or shaping, drilling, reaming and counter-boring; xv. Assembly of a mechanism; xvi. Production of a set of workshop gauges; xvii. Manufacture of a simple press tool.

The preamble to the Final Examination sets the tone and purpose of the course in the following words:

> The purpose of this examination is to ensure that those who qualify in it are competent to appreciate the application of machine shop methods to the manufacture of engineering parts involving some or other of those methods. This should be shown by the ability to explain fully (*a*) how to carry out the necessary operations in correct sequence, giving details of each operation (preferably with sketches of the work and tools), (*b*) the material and form of the tools required, the cutting speeds, particulars of roughing and finishing cuts and methods of measurement [8].

The standard is a high one and the student achieving a first-class pass can truly be accounted a first-class craftsman in the field of metal machining. The successful student may well aspire to supervisory work and become chargehand, foreman, shop manager and in this, as in most other branches of engineering, there is then no limit other than that imposed by his own qualities.

Mechanical Engineering Inspection

This is in the nature of a sequel to machine shop engineering, and is intended for those who have already obtained a Full Technological Certificate in that subject. The course is planned to cover at least 120 hours of instruction, which is about one evening for two years or two evenings for one year.

An examination in two papers is set on a syllabus comprising the following subjects: Organisation of inspection, sampling, principles of measurement, limit systems and gauging methods, nature and evaluation of surface roughness, alignment testing, measurement and inspection on gears, splines and serrations, interferometry and testing of materials.

The examination for this course was available for the first time in 1954, and the training is of particular value to those working on the repetitive production of metal parts, for which a knowledge of inspection methods and procedures is essential, to the inspector and aspiring craftsman alike.

Sheet Metal Work

A course designed to give a broad general craft training for workers in sheet metal up to a thickness of one-eighth inch or 10 S.W.G. and includes all metals, ferrous and non-ferrous, coated and uncoated in normal commercial use [13]. The course normally covers four years, with an Intermediate stage examination taken halfway, and a Final at the end of four years. Intermediate stage subjects are geometry and pattern development, workshop practice, calculations and science and subjects for the Final are geometry and pattern development, workshop practice and materials, processes and calculations. In addition to written work, each candidate for the Final must execute one specimen piece of work during the final year.

A Full Technological Certificate is available.

Welding

Another important City and Guilds course coming within the purview of engineering is Welding. Courses cover both oxy-acetylene and electric-arc welding and usually extend over three years.

First Year. Welding Technology (Electric-Arc and Oxy-Acetylene). Welding Science. Practical Welding (Electric-Arc and Oxy-Acetylene Welding).

Second and Third Years. Welding Technology (Electric-Arc and Oxy-Acetylene). Welding Science. Welding Drawing. Practical Electric-Arc Welding or Practical Oxy-Acetylene Welding.

The examination comprises a written paper in either oxy- or electric-arc welding, a written paper in welding science, a practical test and an examination of specimen work.

Telecommunications Engineering

The City and Guilds courses so far mentioned are essentially craftsman courses. The telecommunications course is designed at a higher level, and is intended to meet the needs of Post

Office staffs and those engaged in manufacture and operation of telecommunications apparatus. It is much more extensive than most City and Guilds courses, and requires from the student attendance for two to two and a half hours on three evenings per week for five years. This 'grouped course' covers much more than the technique of a craft and typifies courses within the City and Guilds' system different in kind from those described earlier.

A preliminary course is recommended to ensure that the student starts with enough basic knowledge and the suggested subjects are: Mathematics (including geometry and mechanics); machine drawing (with special reference to telecommunications plant and equipment); physics (electricity, heat, light and sound).

The subjects of the Telecommunications course are as follows:

First Year: Mathematics for Telecommunications, I; Telecommunications (Principles), I; Elementary Telecommunications Practice.

Second Year: Mathematics for Telecommunications, II; Telecommunications (Principles), II; Telephone Exchange Systems, I or Telegraphy, I or Radio, I or Line Plant Practice, I.

Third Year: Mathematics for Telecommunications, III; Telecommunications (Principles), III; Telephone Exchange Systems, II or Telegraphy, II or Radio, II or Line Plant Practice, II.

Fourth Year: Mathematics for Telecommunications, IV; Telecommunications (Principles), IV; Telephone Exchange Systems, III or Radio, III or Line Transmission, I.

Fifth Year: Mathematics for Telecommunications, V; Telecommunications (Principles), V; Line Transmission, I (if not previously taken) or Line Transmission, II or Radio, IV.

Providing the college course has been approved, the Institute conducts examinations in the foregoing subjects.

An Intermediate certificate is awarded to a student who completes the first two years of the course and passes college examinations in an appropriate selection of subjects.

A Final certificate is awarded after a further two years to successful candidates who pass college examinations in Mathematics, III and the Institute's examination in Telecommunications (Principles), III and IV and in Telephone Exchange Systems, II and III or Telegraphy, II and Line Transmission, I or Line Plant Practice, II and Line Transmission, I or Radio, II and III.

The Full Technological Certificate may be awarded to a student who completes the fifth year of the course and passes the Institute's examinations in Telecommunications (Principles), V and Line Transmission, II or Radio, IV or Line Transmission, I and has attained the age of 21 years.

Arrangements can be made for external candidates at all three levels of certificates.

Allied with this group of work is the British Institution of Radio Engineers, a body founded in 1925 which takes a broader field as its province than that denoted by 'Radio' alone. It is, in fact, the whole field of electronic engineering. The Institution's examination requirements are set out below and for admission a candidate must pass in Parts I to IV: Part I. Physics; Part II. Principles of Radio Engineering; Part III*a*. Mathematics; Part III*b*. Advanced Radio Engineering; Part IV. Radio Transmission, or Radio Reception, or Television, or Electronic Measurements, or Audio Frequency Engineering, or Valve Technology and Manufacture.

Among exemptions from the Institution's examinations City and Guilds Mathematics for Telecommunications, III exempts from Part III*a*, Final Certificate from Parts II and III (*a* and *b*), and Full Technological Certificate or Final Certificate with first class pass in Radio, III and Telecommunications (Principles), IV from Parts II, III (*a* and *b*) and IV.

Electrical Installations Work

The syllabuses and courses of instruction have been drawn up by the City and Guilds of London Institute in consultation with the Electrical Contractors' Association, and the subject is dealt with at two levels.

Course B leads to (*a*) An Electrician's Intermediate Certificate; (*b*) An Electrician's Certificate.

The course is suitable for apprentices engaged in electrical installation work and normally requires three evenings or one day per week for three years. The Intermediate Certificate is awarded on the results of written and practical examinations and the Electrician's Certificate, after the age of 22, on application to the City and Guilds of London Institute, together with a submission of practical training and work.

Course C leads to (*a*) An Electrician's Extra Interim Certificate; (*b*) An Electrician's Extra Certificate, and is suitable for those who desire to qualify for higher positions such as that of foreman or supervisor. It will normally require two years' attendance of three evenings per week. Again, the plan is that the Extra Interim Certificate is awarded on examination and the Extra Certificate when satisfactory practical work has been performed.

The Full Technological Certificate is awarded to a candidate who has obtained both the Electrician's and the Electrician's Extra Certificate, has attained the age of 21 at the time of application and has had appropriate experience in the application of his technology.

Automobile Engineering Practice

This is a group of three courses drawn up by the City and Guilds in conjunction with the National Joint Industrial Council for the Motor Vehicle Retail and Repairing Trade, and the Institute of the Motor Industry, and is designed for those engaged in the distribution and maintenance side of the industry.

The three courses are: (*a*) Motor Vehicle Mechanics' work; (*b*) Motor Vehicle Technicians' work; (*c*) Motor Vehicle Electricians' work.

Course (*a*) requires attendance over a period of three years while course (*b*) is to be regarded as an extension of course (*a*) and will normally require a further two years' work. Course (*c*) is intended to run parallel with course (*a*) and certain parts of the curriculum are common.

First- and second-class certificates are awarded and a Full Technological Certificate may be awarded to a candidate who has passed in any two courses, provided certain other conditions, including practical experience, are fulfilled.

Success in course (*a*) is recognised by the Ministry of Education and the National Joint Industrial Council as satisfying the requirements in respect of the theoretical knowledge for the award of the National Craftsman's Certificate for a Motor Vehicle Service Mechanic.

The Institute of the Motor Industry was established in 1920 and has grades of membership some of which require educational standards. The examination for Associate Membership consists of Sections A, B and C. Section A, Part I, is essentially general education and Part II an introduction to Motor Vehicle technology. Section B may be taken in either Mechanical, Electrical or Commercial groups and may be exempted by a City and Guilds Certificate for Motor Vehicle Technicians. Section C, for which there are no exemptions, consists of: 1. Motor Trade Practice and Management; 2.

Workshop Organisation and Administration, or 3. Sales and Office Organisations and Administration.

Among other City and Guilds courses, which are of interest to engineering students, are:

Boiler Makers' Work; Mechanical Engineering Design; Railway Carriage and Wagon Construction; Aeronautical Engineering Practice; Refrigeration; Welding; Fabrication of Steelwork; Heating and Ventilating Engineering Practice; Electrical Engineering Practice.

Syllabuses and conditions of award may be obtained from the Director, Department of Technology, City and Guilds of London Institute, 31 Brechin Place, South Kensington, S.W.7.

Insignia Award. The Insignia Award of the City and Guilds of London Institute provides a high ranking qualification for those who have acquired their technical training through a City and Guilds course and whose knowledge stems from the mastery of a craft. It is the kind of award to be sought by those who would progress, for example, from the foreman level to shop and works management.

Conclusion

Industrial development is proceeding apace under the stimulus of international competition and from its own momentum. Developments such as atomic fission and the 'electronic brain', with increased 'automation' reaching completion in the automatic factory [14], call for considerable numbers of people well trained in the wide range of engineering techniques and a knowledge of the directions in which research and development are moving. It must not be forgotten that, although certain developments may tend to displace labour and thereby raise major social problems, such developments can only take place and be sustained if a corps of suitably trained people of the very highest calibre is available [9].

The contribution of the technical colleges by way of trained persons is bound to become even greater than at present. In terms of London University degrees technical college students gained 1,191 external degrees in engineering from 1951 to 1953. In addition 5,104 Higher National Certificates and 212 Higher National Diplomas were awarded in the various branches of engineering in 1953. Many of the holders ultimately acquire professional status through corporate membership of one of the professional engineering institutions.

The present contribution to qualifications of this order suffers from two defects. First, the number of Higher National Diplomas, as compared with Higher National Certificates, is far too small, and the second is in the relatively small amount of research at present carried out in technical colleges, which is quite indispensable in any study at the level where boundaries of knowledge are being reached.

The first of these defects is being overcome by the increased support of sandwich courses [10]. Properly organised as to content and entry conditions, with the support of industry which should be axiomatic on the closer co-operation which is developing, these courses will provide a very valuable alternative and complement to degree courses and become the peculiar contribution of technical colleges.

The development of research, both as a means of training students and keeping staff ahead of changes, as well as for its own inherent importance, will be helped forward by the higher grants now available under the terms of the *Ministry of Education Circular 255* and the opportunities which governing bodies now have for appointing research assistants [11].

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CHAPTER IX

BUILDING

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Introduction

After engineering, the building industry and its associated occupations contribute the largest number of students to technical colleges, this number being sufficiently large to permit the organisation of building courses in separate departments in most of the major technical colleges in the British Isles. In the largest centres of population, building studies are partly centred in monotechnics. The outstanding characteristics of the provision of courses are: (*a*) an extensive range of firmly developed craft courses; (*b*) a well established National Certificate scheme including special provision for structural engineering in certain centres. The standards of mathematics and science in National Certificate courses in building are generally lower than in the corresponding engineering courses, and there are other respects in which the building courses show the influence of the crafts on their development.

Full-time courses in building are less well-developed than in engineering, though in this connection it must be remembered that experience in the operation of full-time engineering courses extends over a century, while the corresponding experience in building has been gathered almost entirely since 1920. Furthermore, whereas in engineering the technical colleges have had the benefit of experience gained in the development of university courses, in building they have had all the pioneer work to do. But, however good the reasons for it may be, the fact remains that full-time courses in building are at a relatively early stage in their development.

The present position of building education, outlined above, reflects very accurately certain characteristics of the building industry and building practice. Building practice has retained a very strong craft basis right up to the present time and although certain effects of mechanisation are now making themselves felt, the changes due to this cause have been delayed in comparison with other major industries. Secondly there has during the last 100 years been the unfortunate divorce of the chief designers, the architects, from the producers, the building contractors, and more recently both architects and contractors have given up part of their administrative responsibilities to the quantity surveyors. Building contractors have therefore employed relatively small administrative staffs and practically no designers, which are the occupations most likely to encourage development of full-time courses and the sources from which students for a National Certificate course would normally be expected to be drawn.

Large numbers of craft apprentices and craftsmen have been forthcoming as students, the more ambitious of them anxious to seize the opportunity afforded by National Certificate courses to further their chances of promotion to supervisory positions, and the strong craft influence on the development of National Certificate courses is, in these circumstances, not difficult to understand. Since 1945 considerable changes have taken place in the larger centres and although these have already started to affect building courses, it will be some years yet before the pattern is significantly changed.

Building Craft Courses

There has been a continuous and steady development of building craft studies in evening courses over a period of nearly 100 years. The early enthusiasts were probably concerned more to study building construction and geometry than the practice of their craft, but for the last 50 years workshop instruction has formed an important part of craft courses; in fact the general experience has been that no craft course could be run successfully until facilities for practical instruction in that craft could be provided. Carpentry and joinery and plumbing were the first courses to become firmly established and, taking the country as a whole, the other courses are of recent introduction. The establishment of junior technical schools for building in the London area during the early years of this century probably influenced the relatively early development there of craft courses in brickwork, masonry, painting and plastering. Elsewhere comparatively little provision was made prior to 1930 and no general development took place before 1939. Instruction in woodcutting machinists' work dates from about 1920 and, by 1939, workshops had been equipped at the principal centres.

The structure of building craft courses has changed little since grouped courses became usual during the 1920s. The courses are generally of four years' duration for students entering during their 17th year, and the following shows a typical layout of an evening building craft course (three evenings per week).

First Year	Craft Theory I Workshop Practice I Geometry and Calculations I
Second Year	Craft Theory II Workshop Practice II Craft Science I and Calculations II
Third Year	Craft Theory III Workshop Practice III Geometry and Craft Science II
Fourth Year	Craft Theory IV Workshop Practice IV Building Construction I

The main development of craft science has taken place since 1945 and a good deal of attention has been given to devising a suitable treatment with adequate experimental work. The better students usually take the City and Guilds of London Institute's Intermediate Examination in the appropriate craft at the end of the second year of the course and the Final Examination about two years later.

During the 1939-45 war a variety of circumstances favoured increased attendances at part-time day classes, and the colleges were not slow to take advantage of this development. In a number of towns new colleges had recently been completed or were approaching completion in 1939 and, in all these colleges, building workshops had been provided. Courses in brickwork expanded rapidly until the provision was comparable to that in carpentry and plumbing while provision for instruction in the other crafts was increased on a more modest scale. This advance was consolidated by the introduction and general adoption in 1945 of a National Scheme of Apprenticeship for the Building Industry with a written indenture providing, amongst other things, for the apprentice to attend approved technical courses on one day per week up to the age of 18 and on two evenings per week throughout his apprenticeship. During the period immediately following the end of the war the industry rapidly built up its manpower to the pre-war level and large numbers of apprentices were indentured [4]. In some parts of the country, building employers who would not adopt all the conditions of the apprenticeship scheme were still prepared to release young employees for part-time day classes so that, altogether, the building departments of the technical colleges grew apace.

The influx to building craft courses of students whose attendance was compulsory under their apprenticeship agreement was not without its drawbacks to technical teachers. These part-time day students generally took courses similar to those already provided for comparable evening students, although as shown below the additional time available permitted some broadening of the course and a more thorough treatment of the associated subjects:

BUILDING CRAFT COURSE

Allocation of time in Part-time Day and Evening Course
One day and two evenings (10 hours) per week*

Subjects	Weekly Time (hours) 1st Year	2nd Year	3rd Year	4th Year
Craft Theory	2	2	2	3
Workshop Practice	3	3	3	3
Calculations	1	1	1	1
Geometry	1½	1½	1½	–
Craft Science	1½	1½	1½	–
English and General Studies	1	1	1	1
Building Construction	–	–	–	2

In evening courses, however, a process of natural selection, whereby the less able and less willing students dropped out of the course during its early stages, resulted in the later years of the course being adapted to suit keen and able students. Part-time day students included some who lacked either of these qualities and so were unable to make satisfactory progress in the course.

The City and Guilds Full Technological Certificate has, for many years, been available for students who, besides passing the Institute's Final Examination, produced evidence of having satisfactorily completed a suitably broad course of study. The craft courses outlined above have been acceptable to the Institute for this purpose so far as building subjects are concerned. The acceptance in 1945 of the Full Technological Certificate, in certain circumstances, as entitling a teacher to be recognised as qualified for the purpose of teaching the relevant craft subjects in secondary schools, considerably enhanced its prestige as a qualification to be sought by craftsmen. Many feel, however, that there is too little difference in standard between the Final and the Full Technological Certificates in building subjects, and consideration is being given to raising the standard of the additional studies required to qualify for the Full Technological Certificate so that the holder may justly claim the recognition of his qualification as indicating competence as a teacher or supervisor. At the same time the student not seeking a Full Technological Certificate might have the essential mathematics, science and other general studies closely associated with his craft theory. In this way, it is hoped to gain some flexibility in adapting the course to the capabilities and ambitions of the students, and so to overcome some of the difficulties referred to in the previous paragraph.

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*One day plus one evening is likely to be the general pattern (p. 205).

In the advanced stages of craft courses, considerable developments have taken place during recent years. The Final Examination of the City and Guilds of London Institute, taken, usually, after four or five years study (pp. 113, 150), was normally regarded as marking the end of a craft course. The introduction of new techniques and materials have, for many years, tended to overload the syllabuses and there is a tendency now to abstract specialised studies from the craft course itself and offer a special course, usually of one year's duration, for students already holding a City and Guilds Final Certificate to pursue these specialised studies. Sanitary and Domestic Engineering related to Plumbers' Work was an early example of this type of course and it has been followed by other plumbing courses and by courses in carpentry and joinery. Other craft courses will tend to follow this pattern.

The development of plumbing courses shows certain individual characteristics due to particular features of the trade. Plumbing work has remained largely in the hands of specialist firms even in those areas of the country where general building contractors have centred several trades in their own organisations. The administrative and supervisory staffs of these specialist firms have normally been recruited from men who have come through a craft apprenticeship. The building student seeking further technical studies after passing the City and Guilds Final Examination in a craft, has usually been referred to the National Certificate Course in Building but, owing to the tendency of plumbing to remain a little apart from the main stream of the building industry, the young plumber has preferred more advanced specialised studies and it was this demand which led to the early establishment of the City and Guilds Post-Final Examination referred to above. More recently the Institute of Plumbers has offered an examination for a Technical and Administrative Diploma and, in some centres, three-year courses following the City and Guilds Final Examination in Plumbers' Work are provided for students wishing to take this examination.

Craft courses in painters' work raise certain special difficulties of organisation that apply to a somewhat less extent to plastering. Questions of design and taste influence the selection of exercises for the practical class more strongly in these trades than in any others. These are the building crafts most closely associated with interior decoration and there are a limited number of their practitioners, artist-craftsmen, who are expected to be capable of displaying considerable artistic sense in carrying out the schemes of decoration designed by the architect. In the main, the courses in these crafts were developed, before 1939, in colleges and schools of art and the courses were shaped to meet the requirements of the artist-craftsman. The number of students in the country altogether was small, and included very few rank-and-file apprentices. The influx of building apprentices to part-time day classes after 1945 led to the setting up of painting classes at several technical colleges and plastering courses at a few, and it has not always been easy to secure the necessary combination of artistic taste and sound craft instruction in the practical classes.

The City and Guilds Advisory Committee for Painters' and Decorators' Work has, until recently, held firmly to its policy of requiring candidates for the examinations, particularly the Final Examination, to display the artistic sense of the high class decorator. As a result, relatively few apprentice painters have progressed far in the courses and strong representations have been made, by building contractors, for the arrangements to be reviewed. Extensive revision may soon take place, with new schemes to take account of the importance of plain painting as a basic skill needed by all painters. The special skills of the decorator could occupy the later stages of the course though it is recognised that the future supervisor can, with advantage, concern himself more with plant and equipment. The basic studies may therefore be supplemented, at the higher levels, by alternative courses appropriate to the student's capabilities and interests.

Painting and decorating courses since 1945 have generally consisted, in each year, of the three subjects theory, practical and drawing, the appropriate geometry being included in the drawing while the theory class provided for the calculations and science. Plastering courses have generally followed the usual pattern, and in 1954, City and Guilds scheme for plasterers' work was amended to make formal provision for a freehand and modelling class. There remains some controversy as to whether these courses should be organised in technical or art colleges; in fact, close collaboration is necessary if progress towards a satisfactory position is to be made.

City and Guilds schemes on similar lines have recently been introduced for slating and tiling and for mastic asphalt work. An apprenticeship agreement having been established providing for attendance of the apprentices at part-time day classes, approach was made to the City and Guilds of London Institute to explore the possibility of establishing a scheme of examinations and awards, and in each case a two-year scheme has been set up terminating with an examination described as of 'Intermediate' standard. Attendance of these particular apprentices at day classes ends at the age of 18 and very few attend evening classes beyond that stage. The recognition of the City and Guilds Intermediate Certificate may stimulate apprentices to continue studies, and so lead to the establishment of a Final Examination.

National Certificate Courses

A scheme for the award of National Certificates in Building was introduced in 1929 under the control of a Joint Committee consisting of representatives of the Institute of Builders and the Board of Education. Grouped courses in building subjects had been developed during the previous decade and, while it was generally agreed that the subject Building Construction should appear in each year of the course, there were differences of opinion as to the time that should be given to mathematics, geometry and science and as to the advisability of introducing quantity surveying or any other specialised subject at the third year stage. The study of practical geometry had maintained, in building courses, the place that it had occupied in all the technical studies of earlier periods, this circumstance arising from the problems of large-scale setting out which responsible craftsmen and supervisors were required to do. The demand for at least two classes in geometry was therefore well-supported and on purely educational grounds could be amply justified provided a narrow and stereotyped approach was avoided. The need for at least two classes in mathematics was also generally conceded and the claims of science were actively supported by J. L. Manson at the Board of Education and R. E. Stradling (afterwards Sir Reginald Stradling) who, in 1924, went from the Headship of the Building and Civil Engineering Department at Bradford Technical College to become Director of the Building Research Station.

The grouped courses in building subjects, which came into being soon after 1920, were built up of classes largely composed of craftsmen and craft apprentices, and these students did not readily accept the idea that basic studies of mathematics and science were important nor, in any case, were ambitious standards possible. Manson had, for many years, interested himself in the development of an approach to the teaching of science that would appeal to a student from the building industry, and it was he who supplied most of the ideas for the building science syllabuses which formed part of the building courses. The idea of a building science class was by no means universally accepted; many colleges preferred to offer classes in carpentry and joinery or builders' quantities and then, when the needs of mathematics and geometry had been met, there was no room for a science class. Nevertheless, Manson's ideas made steady progress and, by 1930, many colleges included the subject in two years of the course and some in three, the increase in time for science being generally obtained by reducing the time given to geometry or to special subjects in the third year. The position remains substantially unchanged to-day and the three-year course for an Ordinary National Certificate in Building frequently follows the pattern outlined:

ORDINARY NATIONAL CERTIFICATE COURSE IN BUILDING (BASIC COURSE)

First Year	Building Construction I Building Science I Mathematics and Geometry I
Second Year	Building Construction II Building Science II Mathematics and Geometry II
Third Year	Building Construction III Building Science III Mathematics III

There remain considerable differences of opinion regarding the desirability of specialisation in the third year, but in the larger centres, where students are in sufficient numbers to permit the formation of separate classes, then appropriate specialisation is possible. For example, a class in quantity surveying might be provided for a class of junior surveyors from building contractors' offices, or a class in structural engineering for a class of apprentice draughtsmen from the offices of constructional engineers. In the smaller centres, where students of these types may share the class with many others, the basic course is generally preferable.

When the National Certificate Scheme in Building was introduced in 1929, colleges normally submitted their existing grouped course in building (or something very like it) for recognition, and it was not long before serious differences of view developed between the Joint Committee and the colleges. The Institute of Builders' representatives on the Committee early made it clear that they did not approve of courses designed to accommodate mainly craftsmen or craft apprentices. The limitations on standard imposed by such groups of students were, it was felt, inappropriate in a National Certificate course. On the other hand, as both the Board of Education representatives and the colleges knew, to exclude such students or to set other standards would be to wreck the scheme and from this dilemma resulted very much friction, but in spite of this, the scheme gradually established itself and standards steadily improved.

In 1947, The Institute of Builders withdrew from the scheme and in the following year, a new Joint Committee was set up. The constitution of the new Committee set a precedent in that, in place of a single professional institution, provision was made for the representation of the several interests associated with building education. The Committee includes representatives of the architects, chartered surveyors, civil and structural engineers and of the National Joint Council for the Building Industry. The number of certificates awarded took a sharp step upwards after 1945 and remains substantially above 1939 numbers as may be seen from Diagram 27 overleaf. In the larger centres, National Certificate course students are now drawn mainly from building contractors' administrative staff, whose standard of general education on entry to the course has permitted standards to be raised. Elsewhere the composition of the classes seems to have changed little since pre-1939 days, the distribution of occupations among candidates in 1950 being as shown in Table 39.

TABLE 39

OCCUPATIONS OF CANDIDATES FOR
NATIONAL CERTIFICATES IN BUILDING, 1950

Occupation	No. of Candidates	
	Ordinary	Higher
Craftsmen and Craft Apprentices	823	234
Quantity Surveyors and Contractors' staff	472	142
Architects and Engineers' staff	350	87
Others	98	47
TOTALS	1,743	510

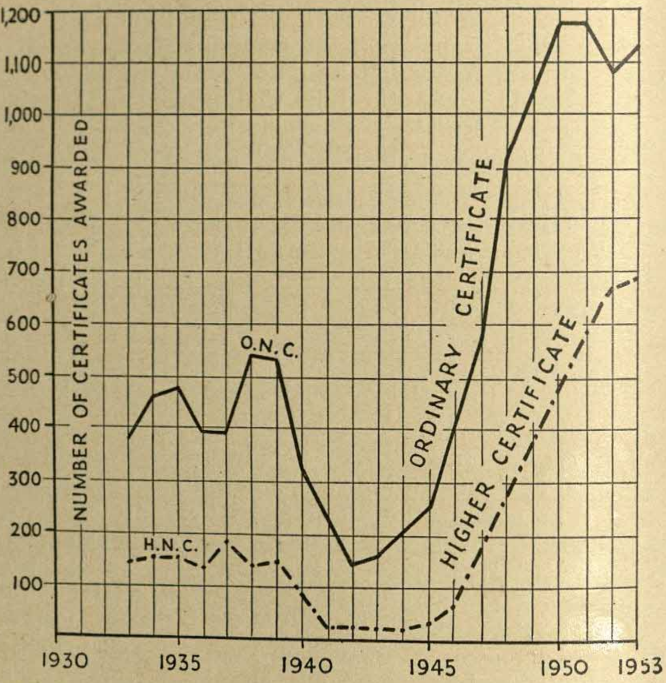

DIAGRAM 27. INCREASE OF AWARDS OF ORDINARY AND HIGHER NATIONAL CERTIFICATES IN BUILDING
Source: Ministry of Education

Higher National Certificate Courses in Building, throughout the period of their existence, have made extensive provision for the variety of interests of students of building departments in technical colleges. For students employed by building contractors, this provision has included subjects such as builders' quantities (or quantity surveying), estimating, accountancy, costing, working drawings, surveying as well as further study of building construction. Classes in theory of structures, structural design and detailing and additional mathematics have been provided for draughtsmen from the offices of structural engineers and subjects such as surveyors' law for the student surveyor or a studio class in building construction for the student of architecture. These last two are typical of the schemes in colleges serving areas where no specialised courses in architecture or surveying are easily available to the part-time student. Particulars of a Higher National Certificate Course in Building, planned to meet the needs of a variety of students, are given below:

Higher National Certificate Course in Building

First Year Building Construction IV
Builders, Quantities I
and ONE of the following subjects
Builders' Accountancy I
Surveying and Levelling
Structural Engineering I

Second Year Building Construction V
together with TWO of the following subjects
Builders' Quantities II*
Builders' Estimates
Builders' Accountancy II* (with Costing)
Structural Engineering II*

The association of structural engineering with building departments may be traced from the work of F. E. Drury, who was, successively, Head of the Building Departments at Salford and Manchester and Principal of Brixton School of Building. At each of these colleges he established strong courses in structural engineering which still flourish there. The interest of the Institution of Structural Engineers in these courses may also be traced to Drury's influence since his advice on educational matters always carried considerable weight in the Institution of which he was President in 1945–6. The Institution, founded in 1908, has 4,399 corporate members (1,316 Members, 3,083 Associate Members), 184 Associates, 1,749 Graduates and 500 student members in 1955.

The type of structural engineering course which Drury established was eminently suitable to form part of the training of the apprentice structural draughtsman and to provide for the most able a means of qualifying for admission to the Institution of Structural Engineers. The retention of some study of traditional building construction ensured that students from these courses had a broader knowledge of construction than is generally found in civil engineers. The course of which particulars are given below is a widely accepted modern development of the structural engineering courses which Drury established.

Structural Engineering Course

leading to the award of Ordinary and Higher
National Certificates in Building

First Year Building Construction I
Building Science I
Building Mathematics and Geometry I

Second Year Building Construction II
Building Science II
Mathematics II

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* The second stage of a subject may be taken only if the first stage has been satisfactorily completed.

Third Year	Structural Engineering I Building Science III Mathematics III (Ordinary National Certificate)
Fourth Year	Theory of Structures I Structural Design and Details I Mathematics IV
Fifth Year	Theory of Structures II Structural Design and Details II Surveying and Levelling (Higher National Certificate)
*Sixth Year**	Structural Design and Details III Structural Specifications, Quantities and Estimates Geology and Soil Mechanics

Courses of this type have been approved for the award of Ordinary and Higher National Certificates in Building since the inception of the scheme and, for many years now, the Institution of Structural Engineers has granted exemption from the Graduateship Examination to candidates holding a Higher National Certificate in Building when structural engineering subjects have formed part of the course. In 1953, this concession was extended to cover the subject Theory of Structures in the Associate Membership Examination for similar Higher National Certificates with endorsements showing successful further study of structural subjects in A.3 year.

Sir Reginald Stradling, as Director of Building Research, encouraged the Institution of Civil Engineers to interest itself in building studies and, when the regulations for the Associate Membership Examination were revised in 1944, there was a separate Building and Structural part of the Section B Examination. At the same time the Higher National Certificate Scheme in Civil Engineering was launched, offering further links with building departments of technical colleges in that a Building Ordinary National Certificate (subject to certain requirements in respect of mathematics) qualified a student for admission to the Higher National Certificate Course in Civil Engineering. Some of the larger colleges having structural engineering courses within their building schemes have utilised the opportunity of providing a Civil Engineering Course, but the number of students is not large (Diagram 26).

The professions of architecture and quantity surveying, which have close links with the building industry, have made comparatively little use of the services of building departments in technical colleges. Account has to be taken in the case of architecture, of the policy of the Royal Institute of British Architects for nearly 50 years, that architects should receive their professional training in full-time courses in schools of architecture (p. 320). In pursuing this policy, the Institute has given little encouragement to the young man employed in an architect's office and preparing for his qualifying examinations by part-time study. Many such young men have studied construction and science in Building National Certificate courses but no official recognition of the awards themselves has been forthcoming. Surveyors, prior to 1945, usually prepared for their examinations by taking correspondence courses, and only in recent years have systematic courses of study been reasonably supported. As the tradition of following organised courses develops, the Royal Institution of Chartered Surveyors may realise the restrictive influence of external examinations upon the development of courses and, profiting from the example of the engineering institutions, be prepared to accord some degree of recognition to suitable courses.

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* The sixth year of the course provides a final year of study for candidates for the Associate Membership Examination of the Institution of Structural Engineers.

Full-time Courses

The problem of devising a full-time course in building is still some way from being satisfactorily solved. It is important that any full-time course should have an exacting academic standard appropriate to its purpose and to its standards of entry.

Standards in courses of study derive largely from complexities in the applications of fundamental principles. In applied sciences, these applications can be analysed and appreciation of the principles systematically developed. This process can be adjusted to suit a considerable range of mental abilities, and courses at the higher levels are therefore suitable for the training and testing of the more able students. Empirical technologies do not lend themselves easily to use in this way because the application of fundamental principles in their practice cannot be analysed. The difficulty of studies based on such technologies tends to become increasingly an exercise of memory and decreasingly an exercise in analysis or in inductive thinking.

Building is still, essentially, an empirical technology except for certain aspects of large scale construction to which theories of structural analysis may be applied. Building practice has been developed empirically over many centuries and the applications of general principles involved are so complex as to defy analysis. During the last 30 years building research has been pursued systematically on a wide front and many sections of building practice are now fairly well understood. But building practice in general is still not clearly understood, and post-1945 experience has shown the difficulty of devising new building methods without extensive large-scale trials.

Stradling believed that, as the analysis of building practice proceeded, a science of building would be distilled and would form the single academic discipline necessary for a building course at a high academic level. While it seems probable that he was basically right, no compact central subject can serve a building course as applied mechanics (with the closely-related hydraulics) serves a civil engineering course. The basic science of building extends over large parts of physics and chemistry and, within the time available, it is not possible to carry all these studies to a level comparable to that of the applied mechanics in a civil engineering course. One solution to the problem may be in the direction of judicious selection of applied science studies within the range of building technology but there is, as yet, no general agreement in regard to the selection.

Apart from considerations such as these, it is not altogether certain that the difficulties of a building course should be entirely of a scientific character. The academic difficulties of engineering courses are mainly mathematical, and this applies not only to university courses but equally to Higher National Diploma and Certificate courses. Whether or not this is a desirable feature of engineering studies (p. 429), there is no reason to adopt it for building. At present, and for many years yet, the main function of full-time courses in building will be to form part of the training of young men who will, ultimately, occupy the senior administrative and executive posts in contracting firms. As such they will require organising and administrative abilities and it would be an advantage if their courses of study could specially indicate and develop such abilities. The use of management principles as a basis for a course of full-time study for students between 18 and 25 years of age is not widely approved in this country, but the development of full-time courses in building might well derive considerable benefit from experiments in this field.

In the main, the present building full-time courses in technical colleges owe a good deal to experience in operating part-time courses. Building construction is a central subject and its treatment differs little as between the two types of course. Essentially an empirical body of knowledge, it is difficult to treat it other than descriptively and difficult to make it other than a test of memory. The standards of mathematics and basic science vary little between part-time and full-time courses, though the additional time available in full-time courses is often utilised to provide a more extensive study of building materials. This study is, again, usually descriptive and offers little essential variety to the course. The studies of quantity surveying, estimating and costing, although approached in much the same way in both types of course, can contribute a very valuable element of difficulty in the later stages and further variety comes from the structural engineering subjects. Certainly, whatever its deficiencies, a building course need never suffer from being narrow.

In part-time courses, limitation of time has led to reliance upon lecturing as a method of teaching and a corresponding tendency for students' abilities to be assessed largely on their performance in examinations set on the lectures. Full-time courses also suffer from these defects, and are particularly liable to do so when their development owes a good deal to experience of part-time courses as is the case in building. Furthermore, where tests of memory play an important part in the examinations the undesirable effects are accentuated and full-time courses in building have much to gain from a new approach in which formal lecturing would be reduced to a bare minimum.

Full-time courses of the type described above are provided in the largest departments of building in Great Britain and generally lead to the award of a Higher National Diploma.

At Manchester, the curriculum is similar to that of many Higher National Diploma courses but the standard of structural theory is particularly high. This course is accepted by the Faculty of Technology of Manchester University and leads to the award B.Sc.Tech. The other university courses in building are, in fact, civil engineering courses with some building studies included in the later years of the course. The number of students who have completed these courses has been quite small. The treatment of building subjects in these civil engineering courses has not influenced the development of their treatment elsewhere though it is probably true that the associated pure science studies at Cardiff have been more ambitious than any others undertaken by building students.

In 1951, L.C.C. Brixton School of Building instituted a new

Higher National Diploma course as a sandwich course (six months college and industry, p.a.) (p. 86). Four winter sessions (October to March inclusive) comprise the course in place of the usual three full years. The sandwich-type course has undoubted advantages for application to an industry, such as building, with a strong seasonal trend and if advantage can be taken of these circumstances, the experiment should have far-reaching effects.

The award of National Diplomas to students satisfactorily completing full-time courses was introduced in 1931 and until 1951, Ordinary and Higher National Diplomas in building (as in engineering) were gained in the same course, the Ordinary National Diploma being awarded at the end of the second year and the Higher National Diploma coming at the end of the third year of the course. When the courses were separated, the Ordinary National Diploma course continued to occupy two years and it was intended that the Higher National Diploma course should be redesigned as a three-year course for a more able type of student, in particular the entrant from the sixth form of a secondary school with two G.C.E. subjects at A level. Provision was made, however, for holders of Ordinary National Diplomas to be excused the first year of a Higher National Diploma course. There seems to be a danger that colleges will design the two courses as a continuous four-year course and, in relying largely upon the Ordinary to feed the Higher course, will defeat the object of the separation. Certainly, in very few colleges is there any considerable direct entry to Higher National Diploma courses either from sixth forms or from among suitable part-time students at Ordinary National Certificate level. Attraction of such entrants is vitally important if the courses themselves are to develop satisfactorily and, also, if they are to serve the industry as it is intended they should.

At present it is possible for Ordinary National Diploma schemes to provide for students to undertake a third year of full-time study for endorsements on an Ordinary National Diploma. Since the endorsements do not count towards either Higher National Diplomas or Certificates, the purpose of the arrangement is obscure and its continuance seems doubtful.

Foremanship and Management Courses

Building has shared in the general awakening of interest of industry in training for management although many circumstances have contributed to a tendency for management studies related to building to develop apart from the main stream. The absence of very large industrial organisations from the building contracting field and the strength of family interest in most building firms, even the largest, have not provided the conditions required for widespread interest in training for higher management. Furthermore, the conditions under which a building contractor works, with short-term occupation of a number of wide-spread sites, accentuate unusual problems of management, and cause building students to find a certain unreality about management studies which have developed principally from work in connection with factory industries. The result has been that the management courses set up during recent years have attracted very few students from the building industry and even more specialised studies set up in certain of the building monotechnics have, so far, attracted only limited support. At present it seems that the most promising line of development lies in the provision of introductory management studies as endorsement subjects on a Higher National Certificate or Diploma and experiments are proceeding along these lines. If full-time courses in building drew more widely upon administrative and organisational problems for their inspiration, the influence upon subsequent training for management would be profound.

Whatever hesitation the building industry may have had in embracing current ideas of training top level managers, there has been widespread interest in training foremen. As with his colleagues in other industries, the builder's foreman has found his work greatly changed since 1939. The shortage of labour and the introduction of new techniques have rendered obsolete the methods on which a pre-1939 general foreman relied for running his job. The general foreman and other members of the building contractor's site supervisory staff have been in the past, and still are normally recruited from the ranks of the craftsmen and the accent of their training has been wholly on practical experience, any considerable background of technical education being the exception rather than the rule. These men did not find it easy to adapt themselves to a rapid change of conditions and, when it is remembered that a considerable number of the most capable and adaptable men left the building industry during the war and have never returned, it will be understood that, in the post-war period, building contractors were faced with an acute shortage of competent foremen.

Such circumstances stimulate an interest in training and

Sir Reginald Stradling, as Chief Scientific Adviser to the Minister of Works in 1945, set up a Human Relations Panel to advise upon problems which he had the forethought to realise would inevitably arise early in the post-war period. A small research unit associated with this Panel was able to collaborate with the London Association of Builders' Foremen and Clerks of Works and with certain technical colleges, in conducting some very valuable experiments in the provision of foremanship studies and when, in 1947, the National Federation of Building Trades Employers set up an *ad hoc* committee to study the whole question of foremanship training, there was useful experience on which to draw and the value of formal study as a part of the training had been established. In its report [1] in 1948, the *ad hoc* Committee recommended a course of study which has since been provided by many colleges. The course was designed principally for the man, usually between 35 and 50 years of age, with considerable experience of carrying out supervisory duties but with little or no background of formal technical study. Some 500 men have now been through a course of this type (or an adaptation of it to suit local conditions) and the immediate need for providing a course of study suitable for existing general foremen has been largely met. The long-term problem of associating foremanship studies with the technical education and normal training of the craftsman was the main subject of a report published in 1953 [2]. Experiments along the lines recommended in that report are likely to provide the main developments of building foremanship courses for the next ten years.

The requirements of a builder's general foreman vary considerably as between those firms which may properly be described as general building contractors and those firms which specialise in one particular trade, e.g. bricklaying, joinery or plumbing. The general contractors, who are found mainly in the southern half of England, besides undertaking the organisation of the whole contract, will also provide the majority of the labour, sub-letting work in only one or two trades, e.g. plumbing, plastering. These are the firms that undertake the largest contracts and they employ, regularly, a considerable number of general foremen capable of handling building projects involving the expenditure of £500,000 and upwards. Many of these large firms now undertake building work outside Britain and have need of general foremen to work overseas and adapt themselves to unusual working conditions. It is firms such as these that are mainly interested in the training of general foremen and, since the headquarters of such firms are to be found mainly in the London area, it is in the London colleges that general foremanship studies have been mainly provided. Elsewhere it has usually been found advisable to provide a course with a wider appeal, and this has been done by arranging a series of lectures or discussions upon various aspects of the foreman's work, each lecture being delivered by an experienced foreman or other suitable exponent of the subject. The Union of Lancashire and Cheshire Institutes offers examinations for a building foremanship course, accepted by the Institute of Industrial Administration for the award of their Certificate of Foremanship Studies. The course is, in many respects, similar to that recommended by the National Federation of Building Trades Employers *ad hoc* Committee but, in common with all courses recognised for this award, it includes subjects that provide a broad background to the more specialised studies. Relatively few men have taken the course.

Although building foremanship studies have, hitherto, developed to a large extent independently of similar courses for other industries, they have already developed considerably without any great tendency to diverge from general practice. The site supervisory staff on building contracts will probably be called upon to assume increasing responsibilities, and foremanship studies, keeping pace with this demand, will require higher levels of general and technical education as a background. The specialised approach it is now desirable to adopt would then become less noticeable and building foremanship studies would be integrated with management studies as a whole. In the meantime, the tendency to integrate foremanship studies with other sections of building education must be regarded as a highly satisfactory feature of their development.

SPECIAL COURSES

Sanitary Inspectors Courses

Courses associated with the training of sanitary inspectors have usually, although not always, been provided in the building departments of technical colleges. In the early days of such courses there was a steady recruitment of adult students who had served an apprenticeship to one of the building crafts (usually plumbing) and, having obtained a City and Guilds First Class Final Certificate in that craft, were eligible for a sanitary inspectors' course. The course itself comprised short series of lectures on various aspects of the work of a sanitary inspector, the instruction being amplified by practical demonstrations and visits. In its fully developed form the course occupied three evenings (6 hours) per week over two sessions. The lay-out of a typical course of this kind is given below.

SANITARY INSPECTORS COURSE (ABOUT 1939)
Based on 6 hours per week evening study

Subject	*Hours study (total)*
First Year	
Building Construction and Sanitation	36
Heating, Ventilating and Lighting	24
Food	34
Water Supply	20
Pests and Vermin	14
Statutes and Orders	18
Statistics	6
Inspection and Administration	24
Second Year	
Drainage, Sewerage and Sewage Disposal	36
Refuse Disposal	12
Prevention of Infectious Disease	12
Food	56
Inspection and Administration	50
Office Routine	6

On completion of the course, students sat for the examination of the Royal Sanitary Institute and the Sanitary Inspectors Examination Joint Board, success in which is the qualification normally required for a sanitary inspector. Students, after passing this examination, frequently returned for a one-year supplementary course in preparation for the Royal Sanitary Institute's examination for Inspectors of Meat and other Foods.

During the 20 years prior to 1939 there was a steady dwindling of adult students from the crafts and a substantial increase of younger men from the offices of local authorities. These younger students had, in the main, reached a higher standard of general education than had previously been usual in the courses but they lacked the background of technical knowledge and practical experience that had characterised the older entrants. In 1938 it was recommended that the younger entrants, lacking any considerable technical knowledge, should take at least the first two years of a National Certificate Course in Building before entering the sanitary inspectors' course proper though it was not until 1953 that this was made obligatory.

In 1945 a serious shortage of sanitary inspectors became evident, due partly to the very small numbers trained during the war years. In order to rectify this position, special short full-time courses were established and filled with carefully selected entrants supported by exchequer grants. The course occupied, in all, 15 months made up of three main sections: full-time study in college, followed by experience with a Local Authority with concurrent part-time day study. These full-time courses were very successful and the men who went through them (740 in all) were regarded in the main as very suitable recruits to the inspectorate. In 1950 the Royal Technical College, Salford, established a full-time course of this type, but it is planned to change this to a three-year sandwich course in order to meet rising standards.

The recruitment and training of sanitary inspectors was studied by a working party which reported in 1953 [3]. The working party supported the idea of a four-year part-time course of study but recommended that the whole course should be specially designed as part of a public health inspector's training instead of the first two years being spent in a building course as previously. It was envisaged that training arrangements would be such that in most cases the students would attend part-time day courses and that it would be possible, therefore, to organise special courses at regional centres where the demand could be concentrated. There is no reason to expect any difficulties in developing the courses in the colleges provided the other recommendations of the working party are implemented.

Concrete Practice Course

The production of concrete as part of civil engineering and building contracts is normally the work of gangs of semi-skilled workers (labourers) in charge of a foreman whose background of experience is often similar to that of the men under him. In these circumstances it has been found difficult to achieve any firm control of the quality of the concrete; in fact, until recent years, little attempt was made to institute control methods because of the training difficulties involved. Of recent years quality control of concrete has made some progress and the need to provide at least the gang foremen with some elementary technical knowledge has become urgent. As a first step toward this end, City and Guilds have recently approved a one-year scheme for a course of one evening per week for 24 weeks with a written and oral examination. It is hoped to extend the scheme, step by step, until the course covers at least three years and a reasonably thorough treatment of the basic aspects of the subject is achieved. Having regard to the fact that the men for whom the course is primarily intended will have had no previous experience of technical study, the development of the courses will be difficult and slow. The project has a special importance since it represents the first step towards the provision of further education for the building and civil engineering labourers who, together, represent over half the total strength of the combined contracting industries.

THE FUTURE OF BUILDING EDUCATION

The current trend in the organisation of building studies is for craft courses to be separated from the large departments, where full-time courses and the majority of advanced part-time courses are provided, and either concentrated in separate colleges or accommodated in contributory colleges. This arrangement, while it has many aspects which appeal to the larger polytechnics, has certain disadvantages among which is the fact that the full-time students are deprived of easy access to live workshops. In the present state of building technology, it is of great value to be able to provide full-time students with the means of studying, at first hand, the nature of the practical problems involved in the work of the craftsman. This study involves a great deal more than trying to do what the craftsman does; it involves seeing what the craftsman himself does in various circumstances. If a workshop is used regularly by craft apprentices, it becomes a live workshop for the purposes of such study and, as such, is a valuable adjunct to the studios and laboratories of the college.

Furthermore, there is reason to suppose that the availability of craftsmen may prove valuable to building departments wishing to undertake the study of characteristic building (as distinct from structural engineering) research problems. In the application of the results of research to an empirical technology, a stage of large-scale experiment is frequently found to be necessary. This is a stage distinct from and additional to the prototype studies normally associated with new developments. So far as building is concerned, a good deal of this large-scale development could well be undertaken in technical colleges and, at the present stage of development of building technique, it would be greatly facilitated by the availability of craft apprentices who could produce the necessary craftwork to a given specification. There are, no doubt, ways in which the polytechnics will overcome these difficulties, but it seems likely that they will be at a disadvantage in respect of the building monotechnics in the development of the most advanced work.

As regards craft courses and National Certificate courses in building, the general impression is one of healthy progress, with a steady modification of existing course patterns to meet the requirements of industry and to bring an increasing proportion of employers into touch with the colleges. Clear advantages have derived from the appointment of personnel managers and training officers by many firms (p. 210) (not only the largest) during the period since 1945, and from the efforts made by certain employers' organisations.

The prospects of development of full-time and sandwich courses are less easily assessed. The interest of a certain section of the industry in such courses has notably quickened during the past five years and there are signs that the development of the courses themselves is advancing. The basic difficulty is that no more than a minute proportion of the more able boys in secondary schools are attracted to building as a career and there are, at present, few signs that the industry is prepared to take action on the scale necessary to achieve substantial advances in the foreseeable future. Effective action would require considerable expenditure on publicity, scholarships and contributions to the cost of providing the courses: having regard to the size of the industry and the degree of industrial organisation already achieved for certain purposes, financing such action should be practicable if a reasonable measure of agreement on policy could be reached. It is here that the guidance of an active professional institution is most missed.

In engineering, the professional institutions have worked hard to secure industrial support for enlightened schemes of education and training. In building, this work has been left to the industrial organisations and, particularly in the last decade, they have achieved as much as could reasonably be expected considering this is not their prime function, and that, in fact, its claims sometimes appear to conflict with the purposes for which they principally exist. The present output of Higher National Diploma and Certificate holders, together with the graduates from the few university courses must ultimately bring into existence a professional institution capable of furthering technical advance and safeguarding standards of professional conduct. This, more than any other single factor, could help to provide for the community the building industry it needs.

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CHAPTER X

ART

By K. HOLMES, O.B.E., A.R.C.A., M.S.I.A.

ARTISTIC feeling like all others is essentially personal, varying with the nature of the one who feels it. Thus we get variety in the Arts, in expression, in methods, in materials, but Art is essentially one subject. Art is expression, beauty put into craftsmanship, and although it is broken into divisions for the convenience of teaching in schools and colleges, a fine balance of judgement and a wide vision are essential to prevent not specialisation, but a biased or one-sided point of view. Art in education appears through all stages from the infants school where freedom and discipline are apparent side by side; and a knowledge and recognition of colour is as important as writing forms and pattern, in fact a complete education in art which can be developed within the educational system. In junior schools non-specialist teachers take art as one of their subjects and at this most prolific age, from 8 to 11 years, there is an intense interest in colour, design and pattern, but the importance given to the subject varies largely with the insistence laid on the general examination for entry to other schools. In the grammar schools art often comes to an early end, at least for the greater part of the students, through undue specialisation. For a great many students entering the university, their art education ceases at the age of 11 and their craft education probably at 14, a deprivation which is rarely noticed, until later in life.

Only by the combined efforts of the various members of staff and of the different schools and institutions can the study of art in its widest sense be successful. The art teacher must be neither pedantic nor vague, essentially persuasive, and entirely in sympathy with his subject and the students he is teaching. The subject of art appreciation is, to a great extent, a cultivation of good taste; not only must this be developed in the designer, but also in the manufacturer, the salesman and buyer. It is difficult to imagine anybody wholly without an appreciation of some thing in which to start to develop this cultivation. It is not a question of creating susceptibility, for it must be there to some extent, even in a small quantity.

The onus of finding the starting point must lie with the teacher. It is all a question of infection rather than subjection. Appreciation must necessarily run parallel with experience, and is generally a matter of slow development. Appreciation of excellence in anything is impossible unless one has gone part of the way along the road, which provides one with this experience. Art is akin to life and part of it, entering as it does into everything we have or see; that it is allied at all to craft and trade is not noticed by many people, yet beauty is obvious in the evidence of man's triumph over mere labour, which can be solely utilitarian. What has art to offer? Its value lies in the production of design, the training of designers, with good taste, and the appreciation of good craftsmanship, thus ultimately raising the standards of public aesthetic judgement.

Art and crafts are a most suitable training ground for the serious business of life, and for the leisure and recreation which diversify it. They involve a discipline not inferior to the most exacting forms of mental experience, and can be pursued with proficiency and pleasure throughout the whole of life.

The volume of art education undertaken is very considerable though it may never compare numerically with that of technical education (but considering the importance of leisure activities, why should this be so?). The analysis of total enrolments is shown in Table 40.

TABLE 40

ENROLMENTS IN ART INSTITUTIONS AND COURSES [1]

Courses	Art Establishments	Other Further Education Establishments	Total
Full-time Day	11,742	44,739	56,481
Part-time Day	28,984	324,065	343,049
Evening	92,508	700,158	792,666
Gross Total	133,234	1,068,962	1,202,196
NET TOTAL*	111,683	913,516	1,025,199

As with other further education, art education is still too dependent on evening classes (and these should increase as leisure interests develop) and part-time day courses are insufficiently developed.

Preliminary Requirements for those Wishing to Undertake Training in Colleges and Schools of Art

In all spheres of art activity, whether in industry, commerce or in teaching, it is imperative to have a good general education.

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* After deducting evening enrolments of day students.

TABLE 41

ART ESTABLISHMENTS

ENROLMENTS IN FULL-TIME AND PART-TIME DAY COURSES [2]

(England and Wales 1952–3)

Subject of Course	Students Full-time Day	Part-time Day
Painting	1,047	1,779
Illustration and Commercial Design (including Lithography, Lettering, &c.)	1,510	761
Printing and allied crafts (including Book-binding)	62	3,726
Dress and allied crafts (including Embroidery)	1,196	5,524
Textile (Printed and Woven) and Wallpaper Design	287	225
Modelling, Sculpture, Lettercutting, etc.	228	278
Pottery and Glass	184	254
Interior Decoration and Painting and Decorating	133	4,326
Silversmithing, Jewellery and allied crafts	66	548
Furniture	75	550
Metals and Plastics (Design for Mass Production)	18	61
Display Work	43	108
Photography	105	124
Other branches of Design	167	81
Intermediate and General Art Courses	4,921	2,795
Architecture	1,126	892
Teaching Course (Final Year for Intending Specialists or Supplementary Courses)	468	174
Miscellaneous and General Crafts	106	8,323
TOTAL	11,742	30,529

The minimum of five subjects in the General Certificate of Education (Ordinary Level), necessary for those wishing to train for teaching, is not a requirement for every art career, but students in any type of training will benefit enormously by being well read, by having a broad basis of general knowledge, and a capacity for sustained effort.

During schooldays, 'being good at art' can have two quite different meanings; on the one hand, ability in drawing is the capacity to record observation with accuracy, and on the other hand, a capacity for creative imagination, involving original ideas. Both these aspects are of importance in any form of art training, though the balance of the two in any one individual is sometimes difficult to achieve.

Draughtsmanship can be considerably developed by training, but imagination is largely a matter of innate capacity. The same can be said of craftsmanship as opposed to ability in creative design. Some combination of dexterity and creative imagination is therefore more than desirable.

A good knowledge of English, and another language is helpful, for this enables the student to keep up to date on art matters through journals published all over the world.

An acceptable standard of spoken and written English will always be important in any career, while in later training in craftsmanship some ability in mathematics is helpful, though with art students this is frequently a weak subject at school.

Conditions of entry to colleges and schools of art vary in different localities, and this also applies to the regulations regarding the award of scholarships and grants. Many art school principals require a report from the headmaster of the secondary school at which the applicant has been a pupil, and there is usually a personal interview, preferably with the parents present. This is reassuring to the parents, for many are unaware of what art training means, and it is well that they should know the conditions and the possibility of posts on its completion. At the interview, the applicant is required to show examples of his/her work in art and craft, though it is difficult to assess innate ability and promise at this stage because of the widely differing types of art teaching in the various schools.

Many schools of art have an entrance examination, others depend entirely on personal interview and recommendation, while it is also a common practice to admit students on the understanding that a place in the school is dependent upon a satisfactory report at the end of the first six months. The regulations regarding age of entry also vary considerably, some colleges take students as soon as they leave school at 15+ for courses not requiring G.C.E. at Ordinary Level so that, if they take the Intermediate Examination in Art, this will be parallel to the Advanced Level G.C.E. which would have been taken had they remained at school. Some pupils stay at school to take the Advanced Level G.C.E. and then proceed to a college of art at the age of eighteen.

Students who intend to take up art teaching must show a capacity for efficient and energetic leadership, have a good voice and bearing, and must have a real interest in children, for the majority of available posts are in schools of general education rather than in schools of art.

For many years, in several schools of art, provision has been made for selected pupils of school age to undertake an alternative to the academic grammar school course. For this purpose junior art departments were established, pupils being transferred to the school of art at about the age of 13 to continue their education with an emphasis on the practical side. At school-leaving age, pupils trained in this way entered the main college or school of art or obtained posts in painting and decorating, window display, commercial art or printing. The balance between general education and vocational training was not always easy to achieve, and many combinations of the two have been attempted. Most of the developments on these lines have now given place to the new secondary technical and secondary art schools (p. 94), with a greater or lesser degree of relationship with the college or school of art.

Scholarships and Exhibitions—Local and National—The Prix de Rome and Others by Professional Bodies

Most Education Authorities award scholarships for art training to enable students to undertake careers in this field. These scholarships vary in amount and are of three types, junior, intermediate and senior. The first is available when the student leaves school, the second after two years' training, often on the result of the equivalent to the Ministry of Education Intermediate Examination which has generally been taken and passed, and the third which applies to the entry of all students at eighteen to take university and college courses. The junior ones are often awarded on the recommendation of the heads of schools and of the head of the art school or college responsible for accepting the student. The Authorities on the other hand, may have art advisers and a scholarship committee to select appropriate students who are likely to confirm the promise shown, if given the opportunity of further training. The value of most scholarships and grants, however, is dependent not purely on merit, but on the parents' financial position; in short, most scholarships are based on a 'means test', a policy largely opposed by teaching bodies and parents alike, but applying nationally throughout all the Authorities. The actual amount of the award varies also according to the generosity of the Authorities and the formula is rarely disclosed.

Scholarships are awarded by certain institutions and many prizes are given annually to schools of art by local industries, and individuals.

The highest award in art is the Prix de Rome. Four scholarships are given each year, one each for engraving, painting, sculpture and architecture, and there is keen competition for them. The maximum age of entry is 28 years, except in special circumstances, and the competition is open to both sexes. In painting, the second candidate in the Final Competition may be awarded the Edwin Abbey Scholarship [3]. The Royal Institute of British Architects offers annually maintenance scholarships up to £100 in value and renewable for a further two years [4]. The Architects' Registration Council of the United Kingdom offers several scholarships which can include grants to cover fees and maintenance [5].

Timetables—Cultural and Vocational

The content of basic training in art consists of objective drawing involving the ability to draw and see accurately, imaginative and memory drawing, and design applied to some craft, which is the culmination of all art training. Most schools have a one-year basic training, included in the two years' Intermediate course of the examination of the Ministry of Education, for which a large number of art students enter. This examination has been devised by the National Advisory Committee on Art Examinations as being a suitable test of preparation and basic training for any career in art. The work in this examination is marked by the staffs of the colleges and schools of art, but assessed nationally by external assessors rather on National Certificate lines (p. 154).

In many cases, on the result of the Intermediate Examination, students are advised on their suitability to pursue a career in art, though many schools turn down unsuitable students at the end of the first year course, which is basic to several subsequent courses. The subjects in this first year vary depending on the equipment available and the qualifications of the staff, and the following is a typical choice of subjects and crafts in the first two years.

Basic or First Year of Intermediate

Drawing subjects in various media	Objective drawing—natural form flower study; Composition; Life drawing; Costume drawing; Anatomy; Geometry and Perspective; Architectural drawing.
Crafts	Basic pattern for printed textiles; Pattern for weaving; Modelling—abstract decorative; Pottery—terra cotta; Carving—wood, stone, plastic; Metalwork—decorative, creative; Embroidery.
Lectures	History of Art; History of Architecture; Heraldry.

Intermediate Second Year

Drawing subjects	Still life—pencil and wash, pen and wash, water colour, tempera, oils; Life drawing; Composition; Anatomy; Architecture.
Crafts	Modelling; Painting; Lettering; Bookcrafts; Printed fabrics; Weaving; Embroidery; Tapestry; Metalwork and enamelling; Wood engraving; Lithography; Lino cutting.

Lectures as first year, but History of Craft included instead of Heraldry.

After the Intermediate course the student may specialise in any subject, in fact, one in which he has not necessarily had any experience. In the other event when a student on entry knows on what he wishes to specialise, he can enter a three-year course specially recognised by the Ministry of Education for the National Diploma, which incorporates its own basic training within the course. These are held only in certain colleges, usually the larger ones, and are particularly applicable to industry, such as commercial art, silversmithing, furniture, interior design, dress design, shoe design, typography. Otherwise the normal National Diploma course extends over four years—two years' specialisation after two years' Intermediate.

Part-time day courses are of two types. Those available mainly for apprentices who are released from industry, generally for two half-days, or one full day per week (p. 205), and those for whom the school serves as a cultural and recreational centre, offering many classes which are purely cultural, craft courses for men and women of all ages interested in these subjects, and not for vocational reasons. Many hand crafts are kept in existence by the patronage of these people who devote so much time to them, and have so much enthusiasm in developing their skills in them.

Evening courses are open to all types of students—specialists, teachers, trade students—in both vocational and cultural subjects, again depending on the status, size and staff of the art school serving the community.

Short courses for industry are provided as part-time classes in which industry expects students to be trained for some specific job or some new skill with new materials. Such courses are also available for teachers who are withdrawn from teaching on one day a week, or for a week-end course (often residential when hostel accommodation is available), again for the purpose of training in some new approach or new activity.

In all courses, some degree of extra-mural or non-classroom activity is necessary and possible. At the present time there are evening classes available on five nights a week, and students under apprenticeship, for example, in building, or printing, are expected to attend two nights a week specifically for vocational training (p. 205), and encouragement is given for cultural, sporting and other activities.

Outdoor study is necessary in art education, as for example, in architecture, one of the basic subjects taken by all full-time art students. Later, in the National Diploma and other courses, students are taken on trade visits, these being incorporated into the full-time timetable, as well as in certain part-time and apprentices' timetables. These activities are part and parcel of the wider educational approach for the industry, and part-time day painting and decorating students may visit a paint or a wallpaper factory as part of their normal day-release course, or sometimes as a special visit in addition. These visits are made throughout the various courses, and industries co-operate in allowing students into their offices and works for part-time training. Day-release is normally one day, or one or two half-days per week, but a short period of full-time study may immediately precede a final examination. Full-time students may spend vacations gaining industrial experience.

Courses for Intending Art Teachers

Specialist art teachers are trained in various ways. Teacher training colleges have a two years' full-time residential course consisting of several subjects, of which art is one. Students may give twice the amount of time to this subject, if taken as advanced art. In certain training colleges a supplementary course provides a third year in advanced art. These teachers are then *qualified* to teach general subjects including art in the primary and secondary schools.

The art school on the other hand, trains the teacher for the Art Teacher's Diploma, a graduate specialist teacher equivalent, for all purposes of status and salary. The Intermediate Examination course previously mentioned is a necessary part, and is followed by a two-year course for the National Diploma in Design for either a specialist subject, or one main and one additional craft.

In colleges equipped for training in relation to a specific industry, students may take a three-year 'special' course, and if wishing to qualify as an art teacher, would be required then to take a one-year intermediate course *after* the National Diploma in Design, and before taking the Certificate of Education, which completes the Art Teacher's Diploma (A.T.D.).

The procedure is either

Intermediate	2 yrs.		National Diploma	3 yrs.
National Diploma	2 yrs.	or	Intermediate	1 yr.
A.T.D.	1 yr.		A.T.D.	1 yr.

The A.T.D. is the graduate qualification of a specialist teacher of art and craft in a secondary modern, technical or grammar school, a school of art, technical institution, or training college. Graduate status can also be obtained through the Diploma of the Royal College of Art, and the Slade Diploma, provided in each case they are accompanied by the usual qualifications in the General Certificate of Education.

Art teachers in colleges and schools of art are drawn from several sources, and have various qualifications: the Art Teacher's Diploma, the specialist National Diploma either in Design for Handicraft, or Design for Industry, or they may be qualified by experience as a designer or craftsman in the local industries which the college of art serves. The recognised qualifications have a certain amount of importance, but personal qualities, industrial and commercial experience are also essential.

After four years' training, and completion of the Intermediate and National Diploma, students wishing to take the A.T.D. must make application to the Clearing House for first choice of one of the sixteen colleges recognised for this purpose: Birmingham, Bournemouth, Brighton, Bristol, Cardiff, Hornsey, Leeds, Leicester, Liverpool, London (Goldsmiths' College and Institute of Education), Manchester, Newcastle, Reading, Sheffield and Swansea. The present Clearing House is at the College of Art, Leeds.

Each of the above centres is a constituent member, together with other training colleges in the district, of an Area Training Organisation run by the Institute of Education of a university. (The School of Art at Newcastle and at Reading are each a constituent part of their respective university). These Area Training Organisations undertake the examination of art students in the Pedagogy Year, and successful candidates are awarded a Certificate of Education. The title of the final award varies with the different university institutes, but where the term 'A.T.D.' is retained, it is the Certificate of Education with the Intermediate and National Diploma that together constitute the Art Teacher's Diploma.

Artists

A person wishing to train as an artist, in painting, sculpture, commerical art or advertising, would in most cases take a general basic training. There is no recognised qualification required by industry, nor for recognition as a freelance artist, but unless a person has a private income he would require to try to establish his reputation as a painter or sculptor, while earning a living in commercial art, or by part-time teaching, for which there are many openings in London and in the provinces. In fact, the part-time teacher, particularly coming from industry, is a very valuable asset to any college teaching community. Training must be basically to develop good taste and aesthetic appreciation, to achieve technical skill and the craft of the various industries. No art school can make an artist, but it can at least give him the grounding on which his art, his creative ability and genius, can develop and later flourish.

The training of the humorous artist is a peculiar problem. Many students, particularly boys, have an aptitude for drawing caricatures, largely influenced by present-day artists, but they generally lack a sense of humour. On the other hand, many humorists lack the ability to draw what they see in a humorous way. Natural humour and humorous art is a combination very rarely found and it is extremely difficult to give advice, beyond stressing the need to improve draughtsmanship. Humorous art is unique, and must be left to develop itself in its own way and by its own appeal.

Designers for Hand Craftsmanship and Industry

Most schools of art provide a basic training course which is followed by the intermediate students, and also by those who wish to specialise for industry, and such specialist subjects can be started during this course. Training as a craftsman will mean that the student goes into a studio as a craftsman to create his own personal work. Many of these hand craftsmen, particularly in pottery, silver and textiles, have had a stimulating effect on the industries and have produced many prototype designs suitable for manufacture. The studio craftsman seeks whatever market is available to sell his own products, and a number of them export their work.

The training of the designer for industry depends largely on the facilities, equipment and teaching staff available, and the school must usually be in the centre of the industry concerned, and supported by that industry. The Ministry of Education recognises certain colleges for taking these various subjects. There are three-year courses for National Diploma in Design, the courses of two years at Special Level for National Diploma in Design, as well as its equivalent in a main subject with an additional subject. There is here no comparison in status as between an Hons. Degree or Ordinary Degree, but it appears that Authorities prefer students who qualify in main and additional courses for teaching in schools of general education, whether grammar or modern, and this appears to be confirmed by the National Advisory Committee dealing with the supply and training of teachers.

The three-year National Diploma courses have a special significance for industry; one, for example, in dress design, is the scheme recommended by the *Light Clothing Working Party Report*, and is related to the recognised scale of payment and conditions of work of one National Federation. A Consultative Committee representing all sections of that industry, locally, and sometimes nationally, acts as an Advisory Committee and may even provide machines, apparatus and equipment, and many of the materials which may be difficult to acquire (p. 213). It advises on factory visits at the end of the first year, and in the second and third years, and arranges also for factory training during the third year of the course for anything from three weeks to a month. Other visits to museums and dress shows are arranged by the college, and distinguished lecturers in fashion, editors of trade journals and manufacturers, give talks on all aspects of dress. A department of this type must necessarily carry a wide contemporary range of materials, but also should have general amenities and facilities which themselves exemplify a high standard of design—for example in refectories, common rooms, and in a few colleges, hostel accommodation also.

The subjects in the first, second and third years are enumerated below:

Dress Design Course—Subjects

Year 1	
Principal subjects	Dress design and dress details; Dress cutting and making; Knitwear, design, flat-cutting and making-up.
Subsidiary craft subjects	Embroidery—hand; Weaving—hand loom; Fabric printing—block and screen for dress; Millinery.
Subsidiary general subjects	History of costume; Life drawing from nude and costume model; Sketching—accessories; Lettering—simple layout.
Year 2	
Principal subjects	Dress design and dress modelling; Dress cutting and making; Knitwear—outerwear, underwear.
Subsidiary craft subjects	Knitted fabric structure; Embroidery—machine; Millinery.
Subsidiary general subjects	History of costume; Life drawing.
Year 3	
Principal subjects	Dress design and dress modelling; Dress cutting and making; Knitwear—outerwear, underwear, swimsuits, slumberwear, cardigans. (n.b. Students may specialise in outerwear or underwear. woven or knitted, in any section.)

Subsidiary craft subjects	Knitted fabric structure, including garment making on circular machines; Embroidery—machine; Millinery.
Subsidiary general subjects	Costume and presentation—all media; Life drawing.

Metalwork in marked contrast presents a different pattern, but again there must be some co-operation on the part of local industry in providing opportunities for the students to carry out actual work, as well as visits to factories, trade exhibitions, museum collections and special lectures.

Art Metalwork Course—Subjects

Year 1	
Principal subjects	Design and practical work—hand processes—set basic exercises; Design and practical work—machine processes—set basic processes; Methods of production; History.
Subsidiary subjects	Metal engraving by hand; Geometrical drawing and perspective; Museum study; Drawing and colour; Lettering.
Year 2	
Principal subjects	Design and practical work—hand processes—set basic exercises; Design and practical work—machine processes—set basic exercises; Methods of production; History of silversmithing; Toolmaking for press and spun work; Design of simple decoration for engraving, enamelling, chasing.
Subsidiary subjects	Metal engraving by hand and machine; Prototypes, model making and casting in plaster; Plating and gilding; Museum study; History and methods of enamelling and chasing; Simple presentation from tracing and blue prints, isometrics.
Year 3	Design of a. ecclesiastical and civic plate b. presentation medals and jewels c. silver and plate for mass production d. mass production in plastic Use of ornament; Enamelling, engraving, casting and chasing; Research in design and tool making for silver and plastics; Production by hand and machine; Presentation drawings and perspective; Study of materials and new approach in development of ideas. (n.b. During the third year, students may specialise in either hand or machine production of metalwork, silversmithing or production of thermosetting plastics.)

These three-year courses are generally bound to local as well as national requirements.

The two-year courses at special level are similar, after the basic training mentioned before, and many schools are recognised for these subjects—fabric design, embroidery, drawing and painting, bookbinding, commercial art, etc., and they follow roughly the same lines as the three-year examples shown. In general, special courses require full-time study, but many schools insist that students do four days per week studying specialist subjects, with the fifth day on subsidiary background and general subjects and activities helpful to them later in life. On the other hand, there are courses where three days are given to the main course and two days to the additional subjects, which are recognised by the National Advisory Committee on Art Examinations.

Hand embroidery may be taken as a handicraft subject for the National Diploma, but machine embroidery for industry would be an entirely different course, determined largely by the limitations of the machines and the stitches they make. They have little in common except the name embroidery, though one may have some affinity with the other, and inspiration can be drawn for machine embroidery from hand embroidery, contemporary and antique.

Similarly furniture may be designed for manufacture in bulk, whereas the handicraft person would produce one piece or suite, largely by hand methods, though, of course, he will use some machines, like the saw and planer. On the other hand, a designer for machines may make some use of handicraft equipment and tools in his training. Nevertheless, though they may have something in common, design for industry is an entirely different occupation from design for craftsmen.

The Industrial Designer and Consultant

The industrial designer and consultant should not be confused with the designer for industry as such. The industrial designer to-day usually is drawn from those with engineering or architectural experience, or with art training, or a combination of them. Describing the industrial design consultant, Mr. F. A. Mercer, Editor of *Art and Industry*, said, '. . . he must be a man of executive calibre. Not only must he himself be a man of imagination and good taste, with an appreciation of the value of good, clean-cut, simple lines, and have a technical background enabling him to understand the nature of materials and methods used in their conversion into products, he must also be able to express his own ideas in graphic form; be able to gather round him, train and inspire, a team of design specialists, working in harmony to a single purpose. Even this is not enough. He must also be tactful, able to get along with executives and technicians in his clients' businesses, and be able to understand their problems and assist their solution' [6].

A few years ago, people for the display industry were gathered from three sources, from the cabinet makers, sign-writers from the painters and decorators, and designers of various kinds, but these have now gradually merged and become a separate profession, with its own essential subjects for purposes of training.

Industrial design grew out of mass production, which calls for a fully developed design prototype before manufacturing begins. Because of the aesthetic limitations of most engineers, technicians and workers on the one hand, and buyers and salesmen on the other, it has become extremely important that education for an artist-designer must be developed with an engineering production viewpoint. The essential requirements are good taste, creative ability, and a knowledge of tooling required for mass production. In the recognised American colleges, following the freshmen's year of foundation art, which is very similar to the basic training in England mentioned earlier, the student must study materials and structure, production methods, two and three-dimensional design, industrial design, aesthetics and history of art, and social institutions. In the following years is added delineation, product development, experimental design, wood technology and human relations. In the final year, the main subjects of the earlier years are continued, plus presentation, principles of photography, market research, a study of contemporary civilisations and great books, and an introduction to science.

Place of Competitions

The question of competitions is a complex one for both art student and staff. Certain professional bodies of standing, the Royal Society of Arts, and publishers of magazines like *Art and Industry* and *Vogue*, encourage competitions in design. Recently, the Institute of Packaging provided a competition for professional designers, as well as for art students.

Art school principals must consider which are desirable and those which should be opposed, for competitions are often promoted locally to acquire a large choice of ideas at a cheap rate, and these compete undesirably with industrial and professional artists. The difficulty often arises in knowing how far such competitions would be of benefit to students, and give an outstanding student the opportunity of gaining some recognition of his merit. Several students have made good by the encouragement of those noteworthy bodies mentioned, particularly *Art and Industry*, a journal which has encouraged several large industrial firms to give specifications and offer prizes for design for their products. Another is the fashion journal *Vogue*, which year by year invites students to enter for a competition, and apart from prizes, gives facilities for six months' experience within the *Vogue* offices, and subsidiary activities, or helps the student to find a suitable post.

The Master Printers' Gold Medal Layout Competition has great popularity in the printing-trade, and in advertising, and engages the interest of industry, the advertising agencies and operatives themselves, as well as art schools, in two awards, Gold and Silver Medals, for those over 21 and therefore in professional practice, and those under 21 years of age. Undoubtedly the stimulus of these competitions has done much to develop higher standards of layout for typography.

Various Examinations and Bodies concerned with them

Ministry of Education. The Ministry of Education has been for many years responsible for the qualifying art examinations in all subjects and established, after publication of the Bray Report, an Advisory Committee on Art Examinations drawn from many professional art, technical and other bodies [7].

The examinations, held annually in May, are run by the Ministry of Education through the National Advisory Committee on Art Examinations, and are examined internally and assessed externally (p. 158). The examiners concerned with the assessment are nominated by the Committee, but representatives of the National Society for Art Education are asked to nominate the teacher assessors, now appointed on the same conditions as the other examiners. It is therefore a natural development that the Intermediate Examination should be mainly examined locally, with a spot test, taken from any group at will, by the Examining Committee.

So far as the National Diploma in Design examination is concerned, the examiners are nominated in the usual way by the National Advisory Committee who choose artists closely associated with industry, often members of the Society of Industrial Artists. In each group of assessors there are again two nominees from the National Society for Art Education. The work done at recognised centres is marked internally and sent to the Ministry together with two sheets of examples of work which has been done during training. Only recently has the work done during the two years of training been considered by the assessors as contributing to the final examination result. Thus, the Bray Committee's recommendation that greater responsibility should be placed on the professional bodies concerned, the schools of art, and Local Authorities, has in fact been accepted in practice.

The City and Guilds of London Institute. Recently, the City and Guilds of London Institute (p. 150), which is recognised as the main examining body for craftsmanship, has made alterations in certain examinations, in leather and clothing technology, for example, to stress the importance of design, and this trend is certainly appearing in other subjects. At the same time, there is no possibility of the City and Guilds Examinations being dominated by design, but it is now a necessary part of the examination.

The changing emphasis with regard to a more scientific content in other courses and examinations is an analogous development (p. 424).

The Royal Institute of British Architects. The Royal Institute of British Architects is not a teaching body but is an examining body whose final examination (A.R.I.B.A.) is now the only qualification accepted by the Architects Registration Council for admission to the Register of Architects.

There are 14 schools of architecture which provide a five-years' full-time course in architecture leading to the award of a degree or diploma which is recognised by the R.I.B.A. as equivalent to the final examination of that Institute. These 'Finals' Schools are visited yearly by two External Examiners approved by the R.I.B.A. and every five years by the R.I.B.A. Visiting Board.

There are four schools of architecture which provide a three-years' full-time course in architecture leading to the award of a degree or certificate, which is recognised by the Royal Institute of British Architects as equivalent to the Intermediate Examination of the R.I.B.A. These schools are visited yearly by one External Examiner approved by the R.I.B.A. and every five years by the R.I.B.A. Visiting Board.

There are many departments or schools of architecture in England and Wales, not recognised by the R.I.B.A., which provide courses in architecture preparing students for the R.I.B.A. Examinations which they then take at a recognised centre.

The Area Training Organisations

Following the McNair Report [8] the universities established Institutes of Education to be responsible for the organisation of teacher training.

Training colleges and the education departments of universities were the first to come under the new system, but when, in 1953, the Ministry of Education relinquished its responsibility for the Art Teacher's Diploma, the colleges of art mentioned on page 313, also became members of their local institutes. In each area, the institute, as the training organisation, has taken over the examination of students training for the teaching profession, whether in the university, the college of art, or in the training colleges. The constituent members co-operate in such matters as assessment, and in the Board of Studies.

Examination requirements vary as between the different institutes, but in general an art student in his Pedagogy Year will be assessed on practical craftwork, theory and written work done during the course, teaching ability and a written examination. The Area Training Organisation provides external examiners, and awards a Certificate of Education.

Professional Bodies Interested in Art and Design

Royal Society of Arts. From time to time, the Royal Society of Arts (p. 154), has awarded bursaries for students, premiums for discoveries and inventions, and awards in Fine Art and Design for Industry [9]. It organised, in 1760, the first public exhibition ever held in this country on contemporary paintings which led to the founding of the Royal Academy, and in 1851 the first International Industrial Exhibition in Hyde Park which was housed in the Crystal Palace.

The Society has been responsible for sponsoring, in connection with various industries, competitions, travelling scholarships, bursaries and prizes for students in industrial design over a long period of time, and these have had special significance and interest, not only to the students but to the industries concerned.

Many of the industries have shown particular interest in the winner, and frequently those gaining travelling scholarships have been offered posts as designers in industry. Another activity of the Society is the seasonal lectures at which the subjects of art and design have been given prominence, and several of the lecturers have been awarded silver medals.

National Society for Art Education (*N.S.A.E.*). Apart from its important long-standing professional activities (p. 166), the

Society co-operates in active partnership with many other bodies to further the cause of education generally as well as art education. A journal is published two to four times a year, which deals with various aspects of art and education, and a conference is held each year [10].

The Society for Education in Art. This Society is a newer organisation, attracting members from the teacher training colleges, and art teachers in schools of general education. Conferences are held from time to time, and exhibitions are organised. The Society publishes *Athene*, an annual Journal of the Arts [11].

The Association of Art Institutions (A.A.I.). Its formation and functions compared to A.T.I. have been noted (p. 163), but its objects may be emphasised here; 'to facilitate agreed action among governing bodies, to promote the efficient organisation and management of art colleges and schools of art and to assist the development of art education'. To this end its main activity is an annual conference held in July at which, over the last few years, interesting papers have been presented. Discussions have ranged over such topics as 'The Artist in the Community', 'The Artist To-day', and 'Imaginative Landscapes of the 19th Century' [12].

The Council of Industrial Design and the Scottish Committee of the Council. The Council of Industrial Design, and its Scottish Committee, set up by the Government in 1944, were the first publicly financed organisations of this kind in the world. To-day other countries, both inside and outside the Commonwealth, are following this British lead.

The Council is a grant-aided body under the Board of Trade charged with the wide and important task of improving the design of British manufactures by all practicable means, but not by controls or dictation. It is primarily an advisory and publicity organisation offering services to industry and commerce, government departments and the public. These services include advice on design policy to manufacturers; advice on the employment of designers; an illustrated index of well-designed consumer goods; selective exhibitions of interest to the home and export trade; publications and visual aids for schools and the public; information and photographs for the Press; advice to the retail trade; photographic, magazine and book libraries; and the monthly magazine, *Design*.

The Council is a small organisation in comparison with the size of job it has to do. Its grant in 1953 was £100,000; its total staff under 100. The 24 Members of the Council, the majority of whom are well-known industrialists and business men, are unpaid and are appointed directly by the President of the Board of Trade [13].

The Society of Industrial Artists. The Society of Industrial Artists is the representative professional body in Great Britain for designers engaged in industry and commerce [14]. The purpose of the Society is to promote the improvement of industrial and commercial design, and the affixes granted by the Society are recognised as a guarantee of aesthetic ability, technical competence and professional integrity.

Among the Society's activities are the establishment of scales of average fees and recognised conditions of contract and employment; and representing the interests and view of practitioners in all matters affecting the progress of design. Membership is open only to practising designers, who are required to submit evidence of their work to a selection committee, and who undertake to observe the Society's code of professional conduct. Design conferences, discussions and exhibitions are arranged by the Society from time to time. The Society's Journal appears six times each year and *Designers in Britain*, a review of commercial and industrial design, is published biennially.

Art Qualifications—Certificate, Diploma, Degree

These titles vary according to the subject, the awarding institution, and the importance given to the subject regionally and nationally. Even the term 'Diploma' has different meanings in that sometimes it does, and sometimes does not, carry graduate status. Therefore anyone wishing to qualify for a career in art education should seek accurate information from the colleges of art, from industry or professional bodies.

Recognition of Training and Salary Scales for Art Teaching

The art teaching profession is represented on the Burnham Technical Committee by two members from the National Society for Art Education (p. 166; Appendix, p. 617). These representatives also serve on the Burnham Reference Committee to deal with all matters regarding salaries of art teachers in any type of institution.

The Royal College of Art

The Royal College of Art was established in 1837 on the recommendation of a Report by a Select Committee on Art and Industries which suggested the formation of a School of Design in which there should be practical as well as theoretical instruction, and also where the direct application of art to manufactures should be deemed essential. In 1896 the School was given the title of 'The Royal College of Art' and from that date granted the Diploma of Associateship. Its mode of governance, finance and organisation have recently been greatly altered, with far-reaching changes, actual and potential, which have been graphically described by the present principal [15].

To-day the College has six separate schools which were originally contained in the School of Design—ceramics, fashion design, graphic design, silversmithing and jewellery (including the Department of Industrial Glass), textile design, wood, metals and plastics, and each school now provides specialist training for designers for industry.

Recruitment to the College is normally by competitive entrance examinations held in January and February each year for admission at the beginning of the following autumn term. These are divided into three parts—submission of testimonies of study, followed later by practical and written examinations at the Royal College of Art, and then a personal interview. Students are not admitted to the College until after National Service has been completed, but may sit the examination before call-up and be granted a provisional place in the College on return from service. Individual students of exceptional ability may be admitted without passing the normal entrance examination. Most students, however, have received some form of training in the schools and colleges of art, for it is considered advantageous for candidates to have had not less than two years' training in a recognised art or technical college, or school of architecture, before taking the entrance examination.

On successful completion of the various courses, the student is awarded the Associateship of the College, but in the separate Schools of Wood, Metal and Plastics, Textile Design, Ceramics, Silversmithing and Jewellery, is awarded a Certificate. The Diploma, Des.R.C.A., is given only after the satisfactory completion of a further nine months working in industry. Both Diplomas, the A.R.C.A., and the Des.R.C.A., together with preliminary general education qualifications, fulfil the requirements of the Ministry of Education Rules 109, and are accepted for graduate status and salary [16].

Slade School of Fine Art

Chairs of Fine Art were established on the bequest of Felix Slade at Oxford, Cambridge and London, and at University

College, London, and he made a further bequest to endow six scholarships in Fine Art and to found a school of art. Students are admitted to the Slade School of Fine Art annually in October, and require a General Certificate of Education with Passes at Advanced Level in one or other subjects, but examination qualifications are not regarded as essential for admission to the Slade School for its Diploma course. Students who enter the course, study for the University of London Diploma in Fine Art [17].

Colleges Recognised for Art Teacher's Diploma

In the sixteen centres recognised for A.T.D. in association with the Certificate of Education of the Area Training Organisations (p. 313), opportunity is given during the one year course for students to have practice and theory in teaching under supervision. A Master of Method is in charge of these teacher training departments, assisted by other specialist members of staff.

Regional Arrangements in Art Education

In 1939 an attempt was made by the Ministry of Education to establish Regional Colleges of Art for the purpose of providing the very best training, i.e. where equipment was available, and to make it possible for uneconomic classes in smaller areas to be transferred to the regional college. A notable achievement of this co-operation was in the Southern Regional Colleges of Art, comprising Southampton, Portsmouth, Bournemouth and Winchester, where advanced training is available at one or other School and each School specialises in one direction or another. Other colleges have been recognised as regional colleges in themselves as at Bradford, Leicester, Leeds, Manchester.

An important advantage of regional arrangements is that industries in rural areas can have facilities for training in the best centres, either in short term evening classes where transport is available, or in longer term training when staff from the larger colleges can be seconded to the smaller schools.

One of the most significant panels established by the several Regional Advisory Councils (p. 135) is that dealing with Art and Design, on which the Council of Industrial Design and the Society of Industrial Artists have been asked to nominate specialists.

Co-operation Between Colleges of Art and Technical Colleges and Universities

Certain subjects, as for example, Printing, may be entirely within the College of Art, or wholly in the College of Technology, or the staffs of both may be jointly responsible for the subject. The joint system occurs throughout art and technical education, the responsibility for the aesthetic side preferably being that of the college of art, while the technical aspect remains the responsibility of the college of technology. Under certain authorities those subjects in which aesthetics and visual appeal are of first importance, come under the control of the principal of the college of art, while in others they come under the principal of the college of technology. The system employed depends largely on local conditions. Besides printing, there is obvious need for co-operation in boot and shoe, textiles, in worsted, printed and knitted fabrics, and for this the sympathy and interest of the local advisory committees for the particular industry is of great importance. In point of fact, in many places, industry has attached little importance to design, aesthetics and appeal.

Painting and decorating has a very close affinity with the building industry, but at its best and in its highest reaches, is much more an artistic craft than a trade, a relationship analogous to that of architecture with building. The success of all teaching depends on the teacher, but the environment is none the less important. The whole range of training and subject matter is closely allied with the artistic crafts with art training, and with the examinations in the college of art.

The college of art sends many of its students to the college of technology for subjects for which it is better equipped with laboratories, machine tools and staff. The college of technology may, and probably does, send students to the college of art, for design, colour and subjects for which it is properly equipped and staffed. Many schools of art are housed within and administratively are integral parts of technical colleges (Appendix, p. 601). Every effort should be made to ensure that the student receives the best possible aesthetic, craft and technical education he needs, no matter in which department this may be available.

Co-operation with the universities is chiefly in connection with the training of art teachers and the examination of students for the Certificate of Education. This relationship between certain colleges of art and university institutes of education is dealt with on page 313. In addition to co-operation between the college of art, the technical college, the university and the primary and secondary schools, there is often a close link with the museum and art gallery. This includes exhibitions as well as facilities for study.

Exhibitions and Facilities available; Design Centres

Many schools of art are housed in buildings of their own, others form a small part of the technical college, or exist in some part of another building, such as a museum. The facilities available for exhibition purposes, therefore, vary a great deal. Those with a central hall for exhibitions are very rare, but in such cases they not only serve their own purposes, but those of various industries for which special exhibitions of particular interest to students and industry are held, and also for the encouragement of a progressive outlook on art and craft teaching in schools of general education.

The establishment of design centres has provided students with fresh opportunities for study, and through exhibitions the contemporary international background has been made readily available. This has been particularly true in the case of the Cotton Board (p. 422) which has had considerable experience in providing lectures and exhibitions, and in the selection of students with ability in design, for direction to the industry.

Unfortunately, the Design and Research Centre for the Gold, Silver and Jewellery Industries has been disbanded, but the Goldsmiths' Company retains a large selection of photographic reproductions of new work of contemporary design, and offers other facilities for study, and for borrowing and buying photographic prints.

The Crafts Centre of Great Britain has a permanent exhibition of work by eminent craftsmen in ceramics, metalwork, textile fabrics, wood engraving, lithography and the like. It was established by certain Craft Societies of Great Britain with the help of the Board of Trade, and the work exhibited is available for sale [18].

The International Wool Secretariat offers probably the widest range of all facilities available on the educational side being admirably equipped to deal with all the technical, aesthetic and fashion aspects of the uses of wool. Its publications are offered free with the exception of *Wool Window*, which shows the part played by wool in display and fashion and is a noteworthy production [19].

The Ministry of Education's Effect on Art Training

The Ministry of Education's action in passing the art examinations over to the National Advisory Committee on

Art Examinations and thus in part to the professional bodies, was an excellent one, for a good deal of co-operation has resulted between the interested bodies, particularly the Association of Art Institutions, and the National Society for Art Education. In fact, had the Ministry asked the profession to take them over earlier, the National Society for Art Education would have been extremely reluctant to do so, but confidence has now been established effectively, with the interest and co-operation of the H.M.Is. and the principals of the colleges. Not only was the Ministry directly responsible for the art examinations, but also for the Royal College of Art until lately, when it appointed an autonomous governing body (p. 508, ref. 32).

The general criticism, which led to the setting up of the Bray Committee [7], was that the examinations did not serve the purpose for which they were intended, except for art specialist teachers in grammar schools and art schools. Although the Ministry of Education has altered the examinations from time to time, with a view to doing two things—making them more applicable for teachers of art, and for designers for industry—it has never succeeded in interesting the various industries.

The new emphasis is on the responsibility of the art teaching profession for the standard and scope of the examinations. There is much internal assessment, and another important point is that now the work done during the period of training for the examination is taken into consideration in the result of the examination itself. This counteracts some of the awkward cases formerly arising where a brilliant student failed wholly on what he had done on the few examination days after two or four years' training. At the same time, the Ministry of Education received no criticism on the punctilious methods of examining and the fairness of conducting the examinations themselves, apart from these anomalies of good students failing which, of course, may still occur. Criticism does not now go to the Ministry but to the committee responsible for the examinations. This committee is divided into two sub-committees, one for the purpose of running the examinations effectively, and the other known as the Schemes Sub-Committee. All schools and colleges submit schemes to the Ministry who in turn pass them to the Schemes Sub-Committee to assess in various ways—as to whether the school has the necessary equipment, the proper teaching staff, adequate number of students, and also whether the subject has any industrial backing.

There is still some criticism to the effect that those responsible for the examination have not yet solved the problems arising from the fact that one examination is considered suitable for two different purposes. The suggestion that one examination should be held for intending art teachers, together with handicraft, and another for those specifically training for industry, is likely to be much discussed in the near future. The solution may lie in some scheme similar to the National Certificates available in technical education for subjects like textiles.

The Function of the College of Art

The college of art is expected first to serve industry, insofar as it is responsible for training designers and craftsmen, gathering together the suitable ability available in the area. Secondly, it must act as a cultural centre for the area, providing non-vocational classes for men and women interested in various aspects of painting and crafts. Thirdly, it should to some extent, act as a corporation department, advising on aesthetics generally, but particularly in such matters as lettering, heraldry, furnishing, silversmithing, pageants and street decorations, printed matter, and interior decoration for civic purposes. Fourthly, the college of art should be a centre for advice and encouragement on all matters concerning art education in the local primary and secondary schools and evening institutes. In most areas the college or school of art provides classes for serving teachers, while in some cases the principal or members of his staff pay regular visits to schools in an advisory capacity.

The standard of design of contemporary exhibitions is now so high that whenever space is available colleges of art should offer facilities in this field. Inevitably a good deal of space is required for this purpose, which some Local Authorities might consider extravagant; nevertheless others consider it an essential part of the activities of a school of art, and therefore of great value to staff, students and the community.

Staff. The scope of activity of a college of art depends on the reputation the college has made in industry. Certain colleges have made their mark there, and some of the smaller schools have made a real contribution to the training and aesthetic side of one certain industry, in whose subject they specialise. The great penalty in art teaching service lies in the present salary scales which are largely based on numbers, for the college of art can never compete with the technical college on numerical strength, but its work is of profound importance to the country's industries and to the community.

Research. This term is normally applied to technological and scientific subjects. At the same time, a form of research is done in a college of art comparable with that done in technical college or university, involving experimental projects and prototype work. In this way a progressive attitude is maintained, and encouragement given to the exploration of new methods and materials in every department of the college.

It is most important that staff and groups of students should have opportunity to do this in connection with individual industries, craft processes, and teaching methods. Moreover their timetables should not be so heavy as to prevent them pursuing their chosen work.

REFERENCES

1. *Ministry of Education Report 1952–3*, Table 40.
2. *ibid.*, Tables 46 and 47.
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No. 4321	F. A. Taylor	Training of Art Students for Industry and Commerce
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CHAPTER XI

WOMEN IN FURTHER EDUCATION

By MISS E. HOLLINGS, B.A. (ADMIN.)

WOMEN take advantage of the further education facilities of this country equally with men. The 1952–3 Report of the Ministry of Education shows that out of 2,061,718 students in all grant-aided establishments 1,061,038 were women. In addition 74,447 women (as compared with 62,756 men) attended adult education courses of various types, including sustained courses. Women are in attendance at practically every type of course offered but naturally the majority of them come for subjects concerned with their personal or domestic life. In 1952–3 there were the following enrolments in classes in domestic and women's subjects:

Full-time students	1,198
Part-time day students	19,113
Evening class *entries*	555,072

The evening class entries have been analysed by the Ministry of Education on a subject basis. Assuming at most two class entries for students, these are equivalent to some 300,000 students. Since they are almost 90% of the total they should give us a fair picture of the order of popularity of women's subjects. They are shown in Table 42.

These figures show that the needlecraft subjects are the most popular of women's subjects and account for 78% of the total class entries, of which dressmaking itself attracts 43%. Cookery has only 15% and the entries for child care and home nursing are surprisingly low. This pattern might possibly change with the spread of facilities, but it is safe to assume that needlecraft subjects will always retain their place at the head of the list.

Needlecraft Subjects

Work with the needle in the making of clothes and home furnishing is traditionally a feminine activity, and it was natural that in the early evening institutes it was the first 'women's subject' offered. In 1896 there were already 1,212

TABLE 42

EVENING CLASS ENTRIES IN DOMESTIC AND WOMEN'S SUBJECTS, 1952–3

Needlecraft Subjects	Major establishments and Evening Institutes	Art establishments	Total
Dressmaking	248,121	10,450	258,571
Glove making	3,560	81	3,641
Millinery	7,207	1,236	8,443
Needlework and Embroidery	102,503	6,964	109,467
Rugmaking and Quilting	11,400	62	11,462
Soft Furnishing	25,276	623	25,899
Tailoring	24,703	1,384	26,087
Upholstery	6,157	180	6,337
Other Needlecrafts	2,982	13	2,995
TOTAL	431,909	20,993	452,902
Child Care and Nursing			
Child Care	999		
Home Nursing	2,796		
TOTAL	3,795		3,795
Other Subjects			
Cookery	83,671	812	84,483
Housecraft	12,222	22	12,244
Laundry	59		59
Miscellaneous and General	1,589		1,589
TOTAL	97,541	834	98,375

institutes which had needlework on the curriculum with dressmaking as an 'advanced course'. Classes in the repairing and making of clothes in those early days of low wages offered to women a real opportunity to help the family economy, and contributed in no small measure to the self respect of its members. Similarly throughout two major wars, when the textile industry was mainly engaged in equipping the fighting men and women, the 'make do and mend' classes made a major contribution both to the family and to the national effort. Even to-day when the standard of living is a little higher and mass production has lowered the price of some clothes, women still find it an economy to make clothes.

But if the time should come when clothes become even cheaper there may be some decline in dressmaking classes, for many women have a strictly utilitarian attitude towards their attendance at classes. The busy housewife will carefully consider what value she can get from the sacrifice of her time and labour. Thus as the price of hats has gradually lowered so has the demand for millinery classes decreased. Just at the end of the last war the shortage of consumer goods brought thousands of women into colleges and institutes solely to make handbags, slippers, gloves and toys. Attendances declined for these subjects as the shops began to replenish stocks in the following years. Similarly, as furnishing textiles became cheaper, and women could themselves make curtains and covers for their homes at very much less cost than they could buy them ready made, there developed an increasing demand for classes where they could be taught the skills of home upholstery and soft furnishing. Many of those who come for utilitarian reasons only, with skilful teaching do become willing to subject themselves to the discipline of learning a craft thoroughly: they then begin to find in their classes an opportunity for creative activity which they can use and develop for their own benefit and pleasure and that of their families.

There are of course always in the classes the true craftswomen with an infinite capacity for taking pains and an innate power to create. Their work in fine needlework and embroidery, often of a remarkable standard, appears in annual exhibitions of institutes all over the country. Neither the utilitarian students nor the craftswomen are examination minded. They find their true satisfaction in the making of things. There are comparatively few women who work steadily through stages of learning to test themselves by the examinations of the regional examining unions and those of the City and Guilds of London Institute (Chapter V). For the year 1951–2 the class entries for needle subjects (in evening classes only) are compared with entries for the examinations of the City and Guilds of London Institute.

	Class entries	Entries for C and G examinations
Dressmaking	307,278	1,275
Millinery	4,846	28
Needlework and embroidery	130,561	475
Tailoring	29,125	79
	470,810	1,857

Of those who take examinations some find careers for themselves in home dressmaking, and many develop into part-time teachers of needle subjects. Some have come in from various branches of the clothing trade to improve their craft. It is from this type of demand that vocational training for the clothing industry has developed (p. 400).

Cookery

Cookery was the second of the women's subjects to be introduced into the early evening institutes. It was a subject which needed more space and more equipment than needlecrafts in the days when money for education was difficult to raise. The first teachers must have had difficult times. We read that in 1886 the Manchester School Board, which was considered a progressive one, provided for each class one gas cooker and one cupboard for equipment [1]. Classes of over 100 were usual and for practice ten students worked at each of ten tables, each student preparing one small part of the main dish and having to be restrained from enthusiastically trying to do more than her share!

Accommodation and equipment problems are still with us. So, too, are the problems of providing teachers. The teachers of cookery in the first women's institutes were the product of those early schools of cookery set up under the patronage of Queen Victoria and with the impetus of the rising public interest in science resulting from the Great Exhibition. The first school, the National School of Cookery, was housed in the Exhibition buildings in 1873 and within the next four years schools of cookery were set up in Liverpool, Leeds, Edinburgh, Glasgow and Manchester. The trained women from these schools were sent out into their local areas where committees of management organised cookery classes for women. They found the newly formed women's institutes fruitful ground both for the teaching of cookery and the training of teachers. But the training colleges which developed from these schools of cookery have ceased, in the main, to provide teachers of adult classes and have concentrated on teacher-training for the secondary school stage. Improvement in salary scales has meant a disinclination on the part of the full-time teachers in secondary schools to do additional evening work and in many areas there is a shortage of teachers for evening classes in cookery.

The proportion of students taking examinations in cookery is somewhat higher than that in needlecraft subjects. In 1952 when class entries (in evening institutes only) were 95,607 there were 1,598 entries for the City and Guilds of London Institute's Examination in Plain Cookery. This is possibly because, accommodation and equipment for cookery being limited, colleges are inclined to give preferential entry to those wishing to take examinations. Most of these students have definite aims of qualifying themselves. Thus the young trainees of the gas and electricity undertakings have always been encouraged to take the City and Guilds examinations up to the part-time teacher's grade in cookery as well as the housecraft examination of the same body. The new gas and electricity boards have continued this policy and now give facilities for day-release. Other students, often mature housewives, set out to qualify themselves as part-time teachers of cookery and find occupation not only in evening institutes but with maternity and child welfare departments, with voluntary bodies and with commercial undertakings.

In the past the domestic cookery classes provided the only places where those engaged as cooks or caterers or those wishing to set up tea rooms could get any help. Over the past 10 years however there has been a most interesting development in vocational training for this work. Nevertheless, the majority of students still come mainly for immediate wishes rather than needs. Many want help, not on the nutritional side of the work which they really need, but to learn to produce attractive dishes. Almost daily there are applications from women for 'high class' or 'fancy' cookery or for cake decoration, when their knowledge of basic cookery is of the scantiest. A good piece of educational work might be done if these women could be accommodated in short intensive courses of the demonstration type that might encourage them to take up the study of cookery and nutrition more seriously. There is certainly a great field of work after the end of 14 years of food rationing to teach young housewives the full use of the foodstuffs which are now available for them.

Domestic Courses

Very few women attending in the evenings take organised courses covering the wider aspects of household management, which require attendance on two or three evenings per week over a period of years. A few take sustained courses leading to the City and Guilds examinations in cookery and ultimately to housecraft, but in 1952 there were only 130 entries for the latter examination.

The regional examining unions offer planned domestic courses, but these are taken by comparatively few and at the preliminary level only. Of the 19,133 part-time day students most attend for single subjects, and it is probable that the 2,284 students released by their employers come mainly from gas and electricity boards and hospital authorities, to take courses in cookery or laundry or housecraft to help them in their jobs.

Full-time domestic science courses are established in specialised colleges and in many women's departments, though the total of 1,198 students is not a large one in comparison say with 11,333 women attending full-time courses for commercial and professional occupations. These domestic courses are used by a few students as a preparation for home life. Some come to fill in time while waiting to begin other careers such as nursing, others come to continue a subject which they have liked at school and because they would like some job connected with domestic science. They may eventually obtain posts as trainee demonstrators for gas and electricity boards or solid fuel equipment manufacturers, or as trainee housekeepers or matrons.

These full-time courses in domestic subjects are usually organised for external examinations. Some colleges take those of the regional examining unions, some those of the National Council of Domestic Studies [2] but most take those of the City and Guilds of London Institute. A typical scheme of work may include cookery and needlework or dressmaking, with housecraft to follow in the second year and including a little general education. Such a scheme though comprehensive in training is inclined to be narrow in its conception, always keeping examinations well in mind. There is not much evidence of wider studies and herein lies a weakness that requires some thought and action. Several of the students who began in this way have continued with courses for as many as four or five years taking as targets the various City and Guilds teacher's certificates (p. 152).

Preparation for Marriage

The bearing and rearing of children is still the most important of all jobs, for without it the race would perish, and it is a task which calls for intelligence and skill of a high order. The mother combines many jobs—that of housekeeper, cook, handyman, dressmaker, nurse, teacher, companion. For her transmissive and appreciatory functions she needs a wide education. To acquire domestic skills and learn the management of the home she needs special training, so that she may be helped to perform her job with as little frustration and as much economy of time and effort as possible. Not until marriage is imminent or she is already embarked upon her new job does she realise her deficiencies. Even then she does not quite know what she wants, and rarely comes for the sustained domestic courses which she really needs. There are of course difficulties for married women. They are still the family bulwark in case of trouble and must bear the strain. The illness of the breadwinner, of the children, of the relative or neighbour, the visit of the plumber, the electrician, the decorator, all militate against the married woman's attendance at classes.

Most women continue working until their marriage, and an increasing number thereafter until the birth of the first child. The first years of child bearing are especially difficult for a woman and it is then, when she needs most help, that her liberty to attend classes is curtailed. There have been experiments in the provision of crèches attached to women's institutes with paid helpers to look after the children, but with space at a premium in most colleges it is unlikely that this type of provision will spread. Even if it were so, it is doubtful whether any but a few mothers would attend except for the classes which give them immediate practical returns in cooked dishes or finished garments. For the subjects the young wife needs urgently—the planning of the work of the home, the wise spending of the family income, the physical and psychological care of the family—there would only be a small response and that probably from mothers intelligent enough to need it least. The great opportunity for this important educational work will come when county colleges are established. Then almost all prospective parents will come within the system of further education and boys and girls can be taught together their responsibilities in family life and some domestic skills.

The further education college will however always have responsibilities in this field. The Ministry of Education Circular No. 117, 5th July, 1946, drew attention to this. Under its stimulus many interesting experiments were made. One venture, arranged for engaged couples, attracted an average of 150 students to a 12 weeks' course which was offered every winter session for three years. The courses were of the lecture and discussion or demonstration type with well-known men and women lecturers. There were, however, very few men in any group and those, elderly bachelors! Similarly to meet the special problems of marriage and homemaking in a foreign country, many colleges ran most successful courses for the English brides of American service men. Courses which specialise in the immediate practical needs of the bride-to-be in teaching her cookery and helping her to make a wedding trousseau can be very successful and some authorities have arranged carpentry courses for the husband-to-be to coincide with these classes.

Colleges need to be constantly experimenting in this kind of work epecially in an effort to reach those who remain untouched by other agencies. Flexibility in arrangement of courses is essential. They might take the form of single lectures or demonstrations, exhibitions, courses of one evening per week for a month, or lasting one day or a week-end. They must be attractive and should be very carefully planned, and directed to special needs, economic difficulties or market changes. Enrolment and attendance should not be hampered by out-county regulations, and it may be that regional committees could help in this respect by organising this type of course on a regional basis.

During the last war in the interests of the nation domestic science teachers carried their 'make do and mend' and food campaigns to homes, markets, stores, factories, waiting-rooms of hospitals and wherever they could make a contact with women. Here is a pattern of provision that could well be followed in peacetime. Colleges, too, have a responsibility to keep abreast of changing conditions in housekeeping—as much as in all their technologies. Indeed the two responsibilities overlap. There is need for the housewife to be introduced to the best equipment, tools and materials to lighten the load of housework. Colleges should help in encouraging the simplification of home life and teach men and women to measure the cost of labour-saving devices against the over elaboration of furnishings. They should give instruction in the simple mechanics of the things they use and of services such as electricity, so that women may learn to use them efficiently and with safety. They need also to learn to treat any accidents that may unfortunately arise from misuse or faulty equipment. Indeed 'First Aid' ought to be part of everyone's education. Here is only a brief indication of the importance of 'domestic subjects' for both men and women.

Personal and Social Studies

The provision of opportunities for personal and social studies is no less important. It is now generally recognised that a knowledge of techniques is not enough for the successful organisation of any business, and similarly in running a home a knowledge of more than housecraft is required [24]. The problem of human relations for instance is as important in the home as in the factory. Men and women need to know how to preserve their own mental health and to create conditions for the harmonious development of the personalities of those in the home. They need to know how to fit into the social group and to realise both the potentialities and the dangers of the impact of the group upon the individual and the family. This teaching could probably best be done in an indirect way. Thus in child care or brides' classes an introduction to such studies might well be given by visiting lecturers, especially by those concerned with the educational work of the Marriage Guidance Council. Tentative plans of this sort have recently been made by at least one domestic science department. The development of such studies should make a material contribution to personal happiness as well as helping to stem the increasing divorce rate and the ill effects of broken and unhappy homes.

Training for Home-making by other Organisations

There are many other agencies concerned directly or indirectly with the domestic education of women. Most of them include instruction in domestic skills even when their purpose may be dominated by religious, political or commercial motives, and many of them aim at encouraging interest in the world outside four walls and in developing a responsibility for it. The political parties have their women's groups; every religious body has groups for girls, for young wives and mothers; the gas and electricity boards and the solid fuel undertakings have their teams of home service advisers who not only give public demonstrations of cookery and laundry-work but visit the homes of women requiring help in the use of apparatus or instruction in cookery. The Electrical Association for Women [3], the Women's Gas Federation [4], and the Women's Advisory Council on Solid Fuel [5], have developed, through an original concern with problems of fuels and equipment, into important and progressive bodies deeply concerned with research into the problems of the housekeeper and with the wider education of women.

In urban areas, community centres have developed their more informal women's groups, and maternity and child welfare departments teach cookery, dressmaking, toymaking and many crafts to the women attending their clinics. In the towns there is also a rapid expansion of the Townswomen's Guilds [6]. In December, 1953, there were 1,565 of them. Their aim is to stimulate the political and social consciousness of women but their provision always includes tuition groups in various domestic crafts. Perhaps the most important women's organisation, certainly in the rural areas, is the Federation of Women's Institutes [7], which has now over 8,100 institutes with a membership of over 420,000 women. Besides working for the public good, and that very effectively, in pressing for betterment of rural conditions, the W.I. movement aims at 'the improvement of individual skills and talents in cookery, handicrafts, gardening, nursing and all the countless jobs a woman may be called upon to do, and the widening of the members' interests through music, drama, reading and lectures and talks on other lands and days'. In the realm of handicrafts the W.I. has shown that women can be encouraged to submit themselves to graded tests to a very high standard and that it is with pride that they keep alive the highest standards of craftsmanship. Most of these associations are helped in small or large measure by those engaged in further education and many of them by financial grants from local authorities. Demonstrators, teachers and lecturers as well as committee members, are often drawn from the staffs of the Women's Departments.

Broadcasting and television services have made some contribution to 'domestic' education. Indeed one of the most popular of all television stars is Philip Harben teaching cookery. But such stimulation of interest is no substitute for the class where questions can be answered, where two-way discussion can range widely and practical work can follow.

The National Institute of Houseworkers

The most recent experiment in comprehensive training for domestic work is for those wishing to earn a living in domestic service and is sponsored by the National Institute of Houseworkers [8]. This Institute was established by the government under the Ministry of Labour and National Service in June, 1946, following the Markham-Hancock report on domestic employment [9]. Nine experimental residential training centres were set up where the standard of training should be such as to gain improved status for the 'houseworker' and a realisation of her social importance.

In the recent period of national economy, the number of these centres has been reduced until only one at Harrow now remains open under the control of the National Institute of Houseworkers. This centre retains the pattern of training which the Institute laid down. The course for girls of 17 and over lasts 26 weeks and includes 20% of general education in addition to training in household skills and practical experience in homes. The course for younger girls lasts nine months and is followed by a year's work in a selected household before they are tested for the Diploma of the Institute. The Diploma is awarded after examination and assessment of all branches of the students' work.

The National Institute of Houseworkers still retains its powers as an examining body and is increasingly used by local authorities for the examination of home helps. It has given some consideration to the training of domestic workers in hospitals and it has done some interesting work in running domestic advice centres in the poorer parts of London. Many technical colleges are doing similar work, and there is scope for a great deal more to be done as accommodation and money become available, and for the establishment of a close partnership between the Institute and the colleges. The Ministry of Education has stated 'that ultimately, training to the standard laid down by the Institute may well form part of the country's normal provision for further education'. (*A.M.220*, 8th April, 1947.)

Courses for Foster Parents

Another type of course in homemaking for those earning a living as foster parents was stimulated by the Myra Curtis report on the care of children [10]. Some technical colleges have collaborated with voluntary bodies responsible for children's homes, with the children's committees of local authorities and with the Home Office in running *ad hoc* courses for those already engaged in this work or full-time courses for selected men and women who would like to become house parents.

Health Education

Health education for women in the form of instructional lectures on positive health has received some attention. In 1938 an urban institution by one advertisement attracted 60 women for a series of talks by the 'family doctor'. A similar series offered after the war brought no response at all, perhaps because the intervening years had produced much more health information in the daily press and the women's magazines and by broadcasting. But in the same year courses styled 'beauty culture' attracted hundreds of women up and down the country. These were really the same health talks with additional trimmings (none the less important) of instruction in make up, deportment and the art of dressing. Most of these courses were frowned upon as frivolous and were closed down during an economy drive, but they were probably as valuable as any course of instruction ever given.

Classes offering physical activities contribute practically to the health education of women, particularly when the instructor is herself interested in the problems of positive health. There were 329,091 evening class entries (men and women) for 'physical culture' in 1952–3. Physical exercises, gymnastic work, swimming, fencing, outdoor games, dancing and movement of every kind are provided for women and they take advantage of facilities with enthusiasm and joy. The Central Council for Recreative Physical Training with the wide scope of its work, including that in factories and clubs, has given even more opportunities for woman in every type of athletics and outdoor sport [11]. Many students develop a high standard and qualify themselves by examinations or summer courses to become part-time teachers of dance or leaders of physical training groups in clubs and youth centres. These classes are mainly for the younger women. There is scope for much more provision for the middle aged where with sympathetic treatment and right exercise many minor physical troubles could be alleviated. In all physical education classes, women should be concerned with posture, good walking and the knowledge of correct adjustment of the body to the kinds of activity that housework demands.

Courses in first aid, home nursing and child care are offered in many institutes. The evening class entries for first aid (styled 'ambulance' in the Ministry's 1953 report) were 15,524. A large number of these would be women and most would attend in connection with their work or because of their membership of the St. John Ambulance Association or the British Red Cross Society. Class entries in home nursing were 2,796. In child care there were only 999. Why are so few women attracted to this subject, so important to the majority of women? The maternity and child welfare departments of local authorities do a great work in this field but only for those who attend the antenatal or post-natal clinics. This lack of interest may be because before marriage the coming of children seems far away and, as we have seen repeatedly in this survey, women are mostly concerned with their immediate wishes and needs. Child care seems less important than dressmaking.

Recreational Classes

The word 'recreational' may lose its significance in the face of the alleged need for economy, but those working in the field of education know that the 'recreational' classes are probably as socially important as the organised courses for qualifications. There must always be provision somewhere of places where women can meet with a mutual interest in making or doing things together. The drama group, the choral society, the gardening class, the flower arrangement class, the reading circle, the speech training group, the handicraft class have by-products in human happiness that are immeasurable. They are often a relief to the overstrained professional woman or the harassed housewife and they have brought solace in human companionship to the bereaved, the old and the lonely. These classes give all those who attend the self-respect of accomplishment and often reveal unexpected talents. It is from these students in recreational classes that we draw many of those willing to study seriously and qualify themselves so that they can in some form give back what the community has given them.

One such went out recently to Malaya with her policeman husband. She began to teach dressmaking to the Malay women in their villages with courage and ingenuity. She devised patterns for the women's traditional garments that made them more comfortable in wear and smarter in appearance. The patterns were printed and the directions translated into the Malay and Chinese language (by the Women's Institute which sponsored her work) and were in great demand. More than that the teacher endeared herself not only to the royal house, but to the crowds that came into the village halls to take their lessons with all their children about them, and who struggled with the teacher through all language difficulties (sometimes indeed with the husband's aid). She brought back to this country a real affection and admiration for these women. She tells how, after the initial lesson which was on the making of a child's frock, the whole group of 30 women turned up the following week with the frocks completed in the finest stitchery and proudly displayed upon their offspring. She tells of private students who when she moved her home still came for weekly lessons across 25 miles of bandit-infested country. Here was a quiet piece of work which will bring rich rewards in human understanding and had its beginnings in a recreational class.

Women who have found a flair for craftwork have been attracted to occupational therapy, or have become teachers of crafts to the blind, the crippled, the deaf and the old and to those in prisons and remand homes. In the war many of these women helped the staffs of colleges to provide craft instruction for service women in isolated stations and contributed greatly to their morale. Men also have come to these handicraft classes provided for women, to find the same relief from the strain of professional jobs in using hands in weaving, rugmaking, basketry, pottery, leatherwork and even embroidery. The importance of this work should never be underestimated.

Service to the Community

Another socially important job, often unknown and underestimated, done by the women's departments and colleges, is their service to the local community. The teachers are called upon to judge innumerable competitions and exhibitions of needlecrafts and handicrafts, to test the cakes and the preserves at the local flower show, to judge public speaking contests, and speak on all kinds of topics to every kind of women's group (and often to men's groups too), to give advice on careers to parents' associations and to act as an information bureau for all matters concerning the further education of women. They are even called upon to solve housecraft and cooking problems by the Press and the general public. They provide *ad hoc* courses of all kinds to meet specific teaching or craft needs of women teachers in evening institutes and sometimes of secondary schools. They hold exhibitions of work which are an encouragement and stimulus to high standards of craftsmanship in their neighbourhood. During two wars they have been live centres of information and help to the women of this country in times of serious shortages. The community can in return give help to its women's department; a few colleges have found that one way in which this can be done is through advisory committees whose members have been drawn from representatives of women's associations or from outstanding women in the area. Such committees have given prestige and publicity to women's work as well as sound advice and practical help (p. 131).

Research

Another service to the community which the technical college should fulfil is that of research and investigation in its own fields of study. This applies equally to women's work. There are some agencies doing interesting work in designing domestic equipment and in kitchen planning on a commercial basis, as for example the Good Housekeeping Institute [12]. The Women's Gas Federation and the Electrical Association for Women have done similar work particularly in regard to their special fuel interests and latterly the National Institute of Houseworkers has done research into the timing of household tasks. There have been studies of many problems of housing and living by staff and students of universities—but far more needs to be done for the benefit of domestic life. With the development of vocational courses for those occupations developing out of domestic work like clothing, catering and laundry work there is just as great a need in these fields.

Colleges should have the closest relationship with industry and with the manufacturers of equipment. The first step towards this liaison is the establishment of effective advisory committees for each trade and for members of the staff to join the professional institutes for which they are qualified. Reduced contact teaching hours for selected members of staff will be essential (p. 541).

Vocational Training

It could be argued that most of the women's subjects are 'vocational' in that they help women in their work of providing for the needs of the family. Let us, however, keep the word for courses leading to paid employment in industry. There are many industries which cater for personal needs and which have developed out of the original work of the housewife. Some, like spinning and weaving, have passed completely from the home and have become major industries. There are others of later growth like catering and clothing which are still mainly unregulated and which work in small units (p. 201). They employ large numbers of women and up to recent years have had a record of low wage rates, and poor working conditions. For many years past great efforts have been made by the enlightened ones in these industries to attract a better type of young entrant, to improve the standards of craftsmanship and to establish approved qualifications.

To that end many of these industries have set up their 'professional institutes'. The catering trade is an example. Certain members began by working for a betterment of conditions and succeeded in getting a Catering Wages Act passed. At the same time the Catering Trades Education Committee was formed with the enthusiastic help of Mr. Macauley Painter, H.M.I. Out of this developed the now flourishing Hotel and Catering Institute [13] which was incorporated in 1949. Like other professional bodies, the Institute is concerned with the advancement of technical and general education among members of the industry, with the interchange of information and ideas and with the setting of standards for entry to the various grades of membership (p. 541). The Institute recognises certain of the examinations of the City and Guilds of London Institute. It also conducts its own examinations in waiting and for book-keeper receptionists, and has recently completed its syllabus of work for its Associateship Examination.

More recently members of the clothing trade have established the Clothing Institute [14] with similar admirable aims and objects (p. 401).

In the laundry trade the Laundry Industry Education Board was set up after the war, sponsored by the Institution of British Launderers [15] and the Association of Women Launderers, and though the pattern is not that of the professional institutes the Board has in common with them a sincere desire to encourage education.

Catering

This industry is the fifth largest in the country. Forty-two per cent. of those engaged in catering are women (who number 368,000) and are more than 5% of all the women gainfully employed. It is an important industry not only in its contribution to the health and well-being of the nation but because of its material contribution of foreign currency from a rapidly expanding tourist trade.

Until 1943 technical education for the catering industry on the hotel side was available only at the Westminster Technical College. Now there are full- and part-time courses at over 100 technical institutions. The natural home for these courses in most colleges was in the women's department. Some colleges attached them to the bakery and confectionery departments while others started new departments for this work.

Full-time Courses. There are full-time courses of training at 38 technical institutions. These are planned at two levels. There are courses for the modern secondary school leaver lasting usually for two years and leading to positions for girls as assistant cooks in hospitals, school kitchens, industrial canteens, or as trainee housekeepers; for the boys as commis chefs or waiters in hotels. There are courses for older entrants from the grammar schools requiring educational qualifications, usually a minimum of four passes at ordinary level in the General Certificate of Education examination. These courses may last for three, four or five years, including experience in selected establishments, and are meant to lead eventually to positions of hotel management. Most of these courses are planned with the City and Guilds of London Institute's examinations in mind and nearly all begin with the 'Basic Training for the Catering Industry', which is wide in its scope and designed to give a training useful in any type of work in hotels or catering establishments. This is usually followed by specialised courses in the second year leading to the City and Guilds of London Institute's examination in

'Cookery for Hotels and Catering Establishments', and the Intermediate Waiting Examination of the Hotel and Catering Institute. Some colleges which provide longer courses award their own diplomas, others provide courses leading to the examination for the Associateship of the Hotel and Catering Institute although the award is not granted until approved experience has been acquired. Book-keeper receptionist courses and other short courses to meet special needs of caterers or hoteliers are offered in some colleges.

Other full-time courses of training, which have developed mainly in the specialised colleges of domestic science, are for women who ultimately wish to fill managerial posts in the school meals or hospital meals services, or in industrial canteens, residential schools, hostels or hospitals. The age of entry is at least 17 years and educational qualifications are required for entry to all types of courses. For those wishing to take the National Certificate of the Institutional Management Association the age of entry is at least 18 years, and the candidate must have a certain number of passes in the General Certificate of Education or equivalent educational qualifications [16]. The course is a wide one and includes practice in large-scale catering. At the end of two years, students sit for the I.M.A. examination and then are placed in junior posts in approved establishments for one year, at the end of which they must pass a second examination, before they receive the I.M.A. certificate.

The Institutional Management Association has a similar scheme of training for women wishing to obtain the matron housekeeper's certificate, but this course is at present available only in two colleges. The National Council of Domestic Studies is used by some colleges as the examining body for similar courses.

Part-time Courses. In 1952–3 there were 7,188 students attending part-time catering courses in the evenings, but so far the development of day-release schemes has been slow. It is admittedly difficult to release young employees from such a personal service as catering and it may be that some form of sandwich course will be the solution (p. 86). With the setting up of the National Joint Apprenticeship Council for the Hotel and Catering Industry, and the introduction of a similar apprenticeship scheme for hospital cooks there ought to be a rapid expansion of day-release. The part-time students come mainly for the same examinations as are taken by the full-time students. Many local authorities and hospital boards recognise the City and Guilds of London Institute's catering certificates for increased wage rates, which is a great incentive though it also brings in some unsuitable students. To meet the needs of specialised groups the Union of Lancashire and Cheshire Institutes has recently introduced several catering courses.

A useful course for those who already have catering experience and who need to widen their knowledge of the science of nutrition is that leading to the Certificate in Nutrition in relation to Catering and Cookery of the Royal Society for the Promotion of Health [17]. The course includes a general introduction to the principles of nutrition and their application, the composition of foodstuffs, nutritional requirements and the effects of cookery on food. It is planned for those in charge of catering establishments, hospital kitchens and school kitchens. The certificate is recognised by the British Dietetic Association, but it does not qualify its holder as a dietitian [18].

Part-time courses for the licensed trade leading to national recognised qualifications have been sponsored by the National Trade Development Association in co-operation with educationists [19]. These are offered in most colleges where catering education is provided and are occasionally incorporated in the third year of full-time training.

Clothing Trades

For various reasons, clothing technology is dealt with separately in Chapter XIII (p. 400). Here it may be noted that a high proportion of the students in full-time courses are women (e.g. 1,143 out of 1,196 in art establishments in 1952–3), as is also true of the 4,596 students in part-time trade dressmaking classes. By contrast few of the 4,092 students of tailoring and cutting are women.

There are as yet no trade examinations for those engaged in retail dressmaking, millinery, the corsetry trade or embroidery. The syllabus in machine embroidery, offered by the City and Guilds of London Institute, was not taken up by colleges and was withdrawn during the recent re-organisation of the needlecraft syllabuses. There is, however, some scope in urban areas for classes in embroidery, both hand and machine, for the dress trades, or for those seeking work with firms specialising in church or badge embroidery or with manufacturers of embroidery materials. These courses are usually provided in colleges of art, but the specialised colleges in London (p. 44), and a few other technical colleges make provision, especially where it is needed for the dress trades.

Nursing

There are full-time pre-nursing courses offered in many colleges for girls between 15 and 17. These continue general education and include the special subjects of anatomy, physiology, hygiene and science to prepare students if they wish for Part I of the Preliminary Examination for State Registered Nurses of the General Nursing Council [20]. There are a few part-time evening courses in existence for girls already in other employment and who wish to keep alive interest in their chosen vocation. One such course under the enthusiastic leadership of an ex-sister tutor has for many years past provided annually 20 to 30 recruits to hospitals all over England. The majority of these have made spectacular headway, perhaps by virtue of the toughness of character which has kept them in attendance at classes for two and three evenings a week for three years (p. 119). For the few who have not succeeded the course has nevertheless provided a valuable education.

The recruitment of girls for nursing still remains very inadequate. In an effort to improve the situation hospital boards have recently instituted 'earning and learning' schemes. The girls are employed in the hospitals and are paid a wage. They attend further education institutions for one or two days each week. They are not allowed to do any work in the wards, but it is presumed that contact with the life of a hospital will keep alive their interest until they are old enough to begin training as nurses. Whether or not the scheme will be successful in its final recruitment of sufficient nurses has yet to be proved, but it is popular in its first appeal.

There are similar courses also for nursery nursing, with part of the week spent in nurseries or nursery schools gaining practical experience and the rest spent in the technical college. Students attending these courses are paid a small weekly wage and the courses are often used as a preparation period before training for general nursing. Others work for the examinations of the National Nursery Examination Board in order to take up posts eventually as matrons of nurseries or in private households [21]. A few continue their general education and enter teacher training colleges to become nursery school or infant teachers.

The women's departments of technical colleges also help hospital authorities by providing courses in invalid cookery and physical training for the students in the nurses' training schools. There are also specialised courses in major establishments for the training of health visitors leading to the examinations of the Royal Sanitary Institute.

Hairdressing

This is a craft with a long tradition and those older men and women who came to practise it after arduous apprenticeship have a respect and enthusiasm for their job. They, like so many other craftsmen, have turned to the technical college to help them to solve present-day problems of training. There is as yet no Joint Apprenticeship Council for Hairdressers* but the various organisations have co-operated in formulating apprenticeship schemes which include the principle of day-release. In 1952–3 there were 758 girls and 99 boys attending in the daytime and 2,603 evening students. In co-operation with the City and Guilds of London Institute, members of the trade have drawn up an examination syllabus which is wide in its scope, including as it does not only saloon training, board work and an introduction to wig making, but also applied science, hygiene and art, English and calculations. The examination is accepted by the Hairdressers' Registration Council [22]. The saloon training of apprentices however presents many problems. Some of the larger saloons are run by business men or women who employ craftsmen and craftswomen. These are unable to spare time and have no incentive to train apprentices. In the small saloon run by the skilled hairdresser the clients expect personal attention and the problem of training is just as difficult. In most rural areas it is almost impossible to train for hairdressing. Since there is a constant shortage of skilled workers in this trade it would seem that there is scope for the development of full-time pre-employment courses. There are such courses well established in London with 36 boys and 173 girls in attendance in 1952–3. Recently a similar course opened in Manchester. These courses are approved by the Hairdressing Wages Council as fulfilling the conditions of apprenticeship for the assessment of wage rates.

Beauty culture and manicure are usually included in the hairdressing courses. A course which might well find a place in colleges where there are well supported classes in hairdressing is that leading to the examinations of the Institute of Trichologists [23], which deal with the health and diseases of the skin and hair. Its duration is normally three years, involving attendance on three evenings a week for the study of chemistry, physics, physiology, *materia medica* and pharmacy, microscopy and the diagnosis of skin and hair disease.

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* A National Apprenticeship Council for the Hairdressing Craft has now been set up (39 Grafton Way, W.3.)

Laundry

Day-release schemes for the training of girls in the laundry trade are in operation in a few urban centres. 'The Learnership Scheme for Girls' is a two years' course. The syllabuses of work are published by the Laundry Industry Education Board, and prominent members of the industry give voluntary service in lecturing on matters of laundry organisation, while college staffs deal with such matters as the physical properties of the textile fibres, detergents and water. It is hoped that the girls who are trained in this way may eventually become the forewomen and supervisors of the industry and that the possibilities of advancement may attract a better type of worker. The City and Guilds of London Institute examination in Laundry is for a more advanced course which may be useful as the learnership scheme progresses.

Staffing Problems

Staffing presents many problems, for the greater part of the teaching is needed in the evenings and must therefore be done by part-time teachers. Not until there is a big expansion of day-time classes can the number of full-time teachers be increased. There were in 1952–3 only 1,604 full-time women teachers for all subjects in all the further education establishments. Like other technical teachers, the full-time women teachers are expected to share the evening load of work and this together with the exacting nature of adult teaching does not easily attract teachers who are qualified to teach in primary or secondary schools, except for short periods to gain additional experience. Nor are the domestic science teachers who teach in the daytime, eager to do extra work in the evenings. The women's departments therefore must rely on other sources of supply.

We have seen how the need for teachers of cookery was first met by the schools of cookery from 1873 onwards. The need for dressmaking teachers was just as urgent, and here the City and Guilds of London Institute began to help when in 1894 the first examination of the Institute to establish a craft standard in dressmaking was held. In 1904 the first examinations were held for teacher's certificate in dressmaking and in millinery. In 1905 the teacher's certificate in needlework was introduced and in 1929 that in ladies' and children's tailoring. The teacher's certificate in cookery was not offered until 1932 when the teacher's certificate in home upholstery was also introduced.

Up to 1953, 76,000 women have taken examinations in the various women's subjects offered by the C.G.L.I., and 8,800 hold the teacher's certificate. From 1945–52 teacher's certificates have been awarded as follows:

Dressmaking	1,149
Needlework	401
Tailoring	8
Millinery	25
Cookery	532

In the main these certificates have been obtained by women of mature experience often with a background of trade training and a competence in the craft which wins the respect of those they teach. They have proved very satisfactory teachers of single subjects to adult students. There has lately been a development in some colleges of schemes of full-time training, particularly in dressmaking, which in the final stages of the course have given younger students the opportunity of obtaining a teacher's certificate. Some of these young teachers have been appointed to full-time posts as needlework teachers in secondary schools under the special terms laid down by the Ministry's Circular 173, 21st June, 1948. Some have found employment in further education establishments either as full-time or part-time teachers.

The scheme of training for the teacher's certificate of the City and Guilds of London Institute has recently been revised (p. 538). The various craft certificates are now offered at two levels and anyone wishing to take up teacher training must first obtain the advanced certificate in dressmaking or any other craft she wishes to teach. It was planned that from this stage the candidate for teaching would then take the newly instituted Technical Teacher's Certificate course, on the assumption that it would be desirable for all types of teachers to study together the general principles of teaching and educational aims and organisation. Strong opinion against this was expressed at conferences of teachers and by principals and staffs of colleges in all parts of the country. One objection was to the late age of entry of 25 years for beginning the teacher training. It was felt that this would prevent women from undertaking courses, that it would cut across the marriageable age and that the staffing position would become even more acute. The scheme of training for domestic subjects will therefore remain independent and under the domestic subjects advisory committee. For teachers of trade subjects or those with trade experience who wish to teach their subjects to domestic classes, the

Technical Teacher's Certificate will be the qualification.

There is a wide range of crafts which are taught mainly to women and for which the City and Guilds of London Institute does not provide any examinations, though regional examining unions and other bodies do offer some. But there are no specific teachers' courses for such crafts as basketry, glove making, slipper making, toy making, hand-loom weaving and leather work. To meet the demands for teachers of these subjects some local authorities have instituted their own training schemes. They have encouraged promising students to practise one or two crafts to a high standard and have then given them a course in methods of teaching. This method of training has also been used for those subjects in which the City and Guilds of London Institute awards certificates. Regional Advisory Councils, too, have helped to train part-time teachers usually in short *ad hoc* courses concerned with the general principles of teaching and special methods (p. 537).

For the training of full-time teachers the technical teacher training colleges might provide an answer to the problem of recruitment of women of some experience of life and trade. The number of women qualified in dressmaking and cookery entering Garnett College is, however, very small (p. 535), and many of those who are trained obtain posts in secondary schools and make no contribution to further education. It is often very difficult, if not impossible, for women with children or dependent relatives to take a residential course, but the scheme is probably not as well known as it should be. Those engaged in further education should be constantly on the look out for likely persons to take up full-time training for technical teaching: for the day will come when the present restrictions on buildings will be lifted and when there will be an expansion not only of domestic subjects, but of full-time and part-time courses in all the trades this chapter mentions. Staffing will then be the most important problem.

Another important source of supply of teachers of women's subjects should be the colleges of art. More students should be encouraged to think of this type of teaching as a worthwhile job. In many colleges those teachers with the Art Teacher's Diploma have greatly enlivened the teaching in women's departments. Not only have they the training to enable them to produce the right environment for this work, but they can make history come alive through their knowledge of the crafts they teach; they can encourage their students to enjoy shape, line, colour and texture and develop their appreciative or critical faculties about all the things they see or use; they can offer wide horizons to their students and show them the joy of creation.

There is a great need, too, for teachers of science preferably concerned with the special problems of women's work. Every woman needs some knowledge of the sciences that affect her life at every level—in the study of the physical and chemical properties of the materials she uses, the food she cooks, in the study of physiology and bacteriology. This will not be immediately apparent to the adult women we teach but it is our responsibility as educators to see that whenever possible we teach not only craft skills, but the underlying principles behind them and so inculcate a 'scientific attitude'. Our special opportunity to do this is with the full-time and part-time day-release students. Herein lies a challenge to the science teacher to 'make friendly the things they use' (p. 424).

Refresher Courses

The Ministry of Education has made generous provision for short courses for teachers concerned with domestic subjects, dressmaking, women's trades, science in relation to women's trades and catering both at national level and in the regions. Regional advisory councils are active in the same field and colleges themselves organise courses to meet special needs. Full-time teachers of trade subjects should refresh themselves by occasional returns to industry. This need will become more apparent as trade courses expand, for then full-time teachers will begin to replace the part-time teachers who still work at their trade and are able to keep abreast of new developments.

Home-making Classes for Men

So far we have been mainly concerned with women's education in those activities which concern their personal or domestic life, and in which men have up to now scarcely participated. But with the development of training for those trades which had their origin in these activities, men are coming into the women's departments in increasing numbers. It is also becoming apparent that men need education for home life as much as women, and that in the mechanics of housework men have a special contribution to make. Men come for many non-vocational courses to the specialised women's institutes classes, and though in London the non-vocational work is kept in separate institutes there is an increasing tendency amongst other authorities to educate men and women together in 'adult centres'. But whatever the title and wherever done, this work is of prime importance, because it is concerned intimately with human needs at both domestic and vocational levels, and it certainly deserves equal consideration with other technical subjects for accommodation, equipment and staffing.

Wider Vocational Training for Women

Women are also coming increasingly into other departments of the colleges as the employers' attitudes change, especially with increasing mechanisation of heavy work (p. 466). This change is indeed a gradual process, but it will be speeded up as the community begins to realise the untapped resources of women's capabilities. Colleges must help to convert public opinion to the value of the vocational training of women.

This country is facing very difficult times. The economic superiority this country once held so easily is gone for good. No less than in wartime we are beginning a struggle which will decide not only our comfort in a welfare state but our very existence. To support a population of 50 millions and an ageing one (p. 182), we are going to need harder and more intelligent work from those who are working, and more workers too. Our only labour reserves are the women of this country (p. 465).

The last census showed a population (of those of 15 years and over) of 18·4 million men of whom 16 millions were gainfully employed, and 20 million women, of whom only 7·3 millions were gainfully employed. There are therefore in this country over 12 million women who do not work for wages. Some are too old, some are occupied with very young children, but a large number of the middle-age and middle-income group are still by convention expected to remain at home to give devoted personal service even when families are grown up.

A community fighting an economic battle must, as it did in wartime, call upon its woman power. It should indeed use all its labour power to the best advantage and invest in the training of both men and women for those jobs or professions they are best fitted by intelligence and temperament to perform. In the past, marriage has been too readily assumed as the end of women's economic life, and further that in the waiting period before marriage it is a waste of money and time to train women. Industrialists, educators, parents and women themselves have all assumed this. Many highly gifted girls have been denied university training on this assumption, and even on lower levels training is not easily obtainable for girls. For example, we may compare the day-release figures of 52,287 for girls as against 256,968 for boys.

Many would argue that it is in the best interests of the family that the mother should remain at home in the early formative years of her children. Many working-class mothers, however, have always had to work outside the home for economic reasons, and one in three of the gainfully employed women are married (though the census figures do not tell us how many of these are mothers). During the last war the women of Britain played a greater part than the women of any other country. They were helped to do this not only by government provision of nurseries and British Restaurants, but also by industry itself which organised the work so that women could not only have their children looked after, their laundry collected and delivered, but hours so arranged that the household shopping could be done. Similarly to-day, industries which are desperate for labour offer part-time jobs to suit almost any convenience of married women.

If we train our women, and particularly if the training is long and expensive, it would be uneconomical if the community did not make the best use of their services; and so society will need to think round all the problems involved in the employment of women [24]. Thus, we could rethink the whole problem of housing. Are we, for instance, too conservatively attached to the idea of the small private household, each with its own heating, cooking and washing problems? Commercial enterprise only has experimented with the service flat. A few local authorities have tried out heating schemes, some have provided communal laundry facilities, if not services, but there is room for much more experiment on the best ways of providing food, warmth and shelter for the human family.

The training of the specialist houseworker is being tried out by the National Institute of Houseworkers, who have also experimented with the provision of a houseworker service; but the numbers are very small. We hear of men who undertake spring cleaning duties. Here are ideas that might prove very fruitful. A corps of houseworkers run by a local authority would be as socially valuable in its help to professional and business women (single or married) as to the sick and incapacitated. Both groups of workers would do the jobs for which they have been trained with efficiency and each would feel pride in its execution.

Re-training the Middle-aged

For those women who have found their true vocation in rearing a family, middle age often brings a bleak and unhappy period after the last son or daughter has left home. Many such women develop neuroses for lack of absorbing and worthwhile activities. Some women find relief from boredom and loneliness in a club, some come into the colleges to learn new crafts: some find satisfaction in working for voluntary societies, and the rare few find opportunities of great service in local government. There are, however, many who find no such outlets. Here is a source of energy that might well be put to good use. Colleges could provide opportunities for the training or retraining of these women, and industry and commerce would find in them mature, sensible and reliable workers.

H. G. Wells suggested that in the education of women it might prove a better arrangement 'to have a resumption of definite study by women and the taking on of new tasks and responsibilities by them round about the ages between 35 and 50. A girl should, of course, be educated from the beginning to look beyond the romantic phase of life, to regard that phase as partial and terminable, to consider the concluding years of life not as a process of growing old—growing out of things, but as a going on to a new system of activities' [25].

The Wider Cultural Education of Women

It is a matter of supreme importance and even of urgency that women should be educated as fully as possible, for women in their transmissive function as mothers and teachers, and in their appreciatory rôle as sweethearts and wives set the standards of the nation. On a material plane they set the standards of consumer goods: on a higher level they are responsible for our public standards of morals and behaviour [26].

We need, then, cultivated women who can appreciate and enjoy the rich gifts that life can bring in the full and joyous exercise of body, mind and spirit, in the sharing of that rich heritage of art and crafts, music and literature which other lives have given to the world. They should learn what they owe not only to those who have lived, but also to the living, for the material benefits they enjoy. They will thus become increasingly aware of themselves in society and of the social significance of the work they do.

Such an education and training should be designed to fit women to perform all their tasks, whether in the home or the outside world or in both, with the maximum efficiency and the minimum of frustration and thus produce happy fulfilled human beings. More than this it should aim at producing what society is going to need very desperately—women with flexible, adaptable minds to face changes that are inevitable.

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CHAPTER XII

COMMERCE

By E. THOMPSON, M.A., B.Sc., Ph.D.

Commercial education to-day covers a vast field of education and training for young, and not so young, men and women who intend to enter, or are already engaged in, one of the many careers open to them in the business world. The business world includes not only the commercial firm as such, but the commercial side of industrial firms, and also a great variety of undertakings concerned in such specialised branches of business as shipping and forwarding, exporting, transport in its many differing aspects, banking, insurance, and the stock exchange. It also includes the services of accountants, company secretaries and the members of other professions closely associated with commerce and industry.

The scope of commercial education extends from the training of the shorthand-typist to courses of study leading to the examinations of the great professional associations, and to examinations for the degrees in Commerce or Economics of London University, and, more rarely, of other universities. If we exclude momentarily the more elementary education for commerce which is carried on in the secondary commercial school, or in the commercial courses provided in secondary modern and secondary grammar schools, the great bulk of commercial education and training is undertaken in the major colleges of commerce, of which there are about a dozen in Great Britain, or in the departments of commerce in the technical colleges. A considerable volume of preliminary work on a part-time evening basis is also carried on in evening institutes and other forms of continuation class centre, as also in training departments established by many of the larger firms for their own employees. Nor must the correspondence colleges be forgotten. Their courses of instruction are of great value to students who live in areas remote from a commercial or technical college.

The courses of education and training for commerce provided by the colleges of commerce* vary from full-time courses extending over as long as three or four years, to a plethora of part-time day and evening courses in the many specialised aspects of business education. The part-time day release of students in the commercial field is much less common than in the field of technical education; nevertheless, there are encouraging signs of progress in various parts of the country. But so far as the whole of Great Britain is concerned, the great bulk of commercial education is still conducted in part-time evening classes, and this is in marked contrast to current practice in the United States of America (p. 380).

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* For convenience this term will hereafter include the commerce departments of the major technical colleges.

Secretarial Courses

At the elementary stage, full-time commercial education largely consists of courses of secretarial training, extending over one or more years, taken by young women students who hope to secure posts as junior clerks, shorthand-typists, copy typists or private secretaries. Such courses may include, in addition to shorthand and typewriting, English (both spoken and written), commercial practice, an elementary treatment of book-keeping and accounts, economic geography and/or history, and occasionally one or more foreign languages. Much depends on the age of the students concerned, their previous educational background and the type of institution in which they are receiving their training. Thus less will be required from a student in a secondary modern school, where the bulk of her course will consist of general school subjects, than in a secondary commercial school, with a selective entry and a more definite vocational bias, although here, too, general or background subjects of a non-commercial character are usually introduced into the curriculum. Again, a course in the 'commercial sixth' of a secondary grammar school may include economics and possibly statistics; on the other hand, a course for university graduates in a commercial college may well contain secretarial practice and certain aspects of commercial and company law.

There is thus much variety in the standard and composition of such secretarial courses, each designed to turn out a very valuable product from the point of view of the business firm. Rarely in Britain are courses in secretarial work so elaborately developed as are the courses in many American universities which lead to a degree in secretarial science. Perhaps the most comprehensive courses in this country are those which lead to a diploma in secretarial science in a few major colleges of commerce. These may extend over as much as three sessions of full-time education, or alternatively two sessions of full-time education followed by a further two sessions of part-time classes. Admission to such a course is usually confined to students who hold a School Leaving Certificate/General Certificate of Education with an appropriate number of passes, including a pass in English.

In part-time day or evening classes less can be attempted, and a reduced course content usually includes, in addition to shorthand and typewriting, English, an elementary treatment of accounts, commercial practice and office routine, and occasionally a foreign language. A great many students, however, confine themselves to the first three subjects mentioned above.

Much speculation exists at the present time as to whether too many students are studying shorthand as distinct from typewriting, for the fairly sound reason that there are far more typists required by business firms than shorthand-typists. Aptitude tests have been mooted, but not yet satisfactorily evolved, as a means by which students who are unlikely to reach a satisfactory speed in shorthand may be discovered in advance. If satisfactory tests can be devised, their use may well cut down the appalling number of failures in this subject which occur annually, but it will be a much more difficult matter to persuade the average student that it is in her best interests to omit shorthand from her course. The lot of a copy typist is not invariably a glamorous one, especially when it is not linked to the hope of becoming one day a secretary to a virile and handsome business executive, a situation which Hollywood has not been backward in associating with romance [1].

Full-time Diploma and Certificate Courses

Full-time diploma and/or certificate courses, extending over from one to three years, form the basis of the work of the colleges of commerce, admission being generally confined to students with a satisfactory School or General Certificate. There is considerable variation in the content and scope of such courses as between one college and another. In some colleges one finds a one-, or possibly a two-year course for ex-grammar school boys, designed to be completed before they enter employment or take up their period of National Service. Elsewhere, a diploma course may extend over three years and approximate to a university course in standard. In Scotland, a diploma may be awarded only to a student who has completed a course of study in a central institution extending over a minimum period of three years and such a diploma, endorsed by the Scottish Education Department, has the standing of a pass degree of a university. The diplomas are awarded only to students who, in addition, have satisfactorily completed a minimum period of six months' practical experience, undertaken during two or more summer vacation periods, with selected business firms which co-operate with the college in ensuring that such training is both varied and informative.

In certain colleges, full-time courses extending over three or four years are arranged for students preparing for the external degree in Economics of the University of London. The introduction of such courses is partly explained by the undoubted prestige which is attached to a university degree as distinct from a college diploma, due again to the fact that the commercial and technical colleges of Britain have not yet acquired sufficient status in the eyes of the nation as a whole (p. 14). From an educational point of view this tends to prevent the colleges concerned from adapting their courses to meet the special needs of their own locality. In point of fact, the new regulations relating to the Economics Degree at London University have made it a much less suitable qualification for business than was the Commerce Degree which has recently been abolished.

The Carr-Saunders Committee [2] recommended that in place of a full-time diploma course, a sandwich course might well be introduced by the commercial colleges. Such a course, extending over three years, would be made up of alternating periods of six months in business and six months in college (p. 86), and would lead to a diploma which should approximate to the standard of a university degree. It would resemble closely the 'co-operative courses' successfully introduced into certain American universities. The liaison which has been developed there with the business firms enables full-time university staff in certain cases to organise and supervise the work of the students in the firms themselves, thus ensuring the highest degree of correlation between academic work and practical business experience.

Similar courses may well be introduced in this country during the next few years, for there is growing evidence that more enlightened employers are becoming increasingly conscious of the advantages of daytime courses as a means of training the more promising of their junior employees. The proposals of the Committee have, nevertheless, been criticised on the ground that it is scarcely possible to visualise a diploma which reaches degree standard, but which involves only three periods of six months' attendance at college.

The full-time work carried on at the more advanced stage in the colleges of commerce of this country still remains relatively small. In sharp contrast to America, business men in this country have no real appreciation of the value of pre-employment training for business, and, regrettably, the part-time evening class is regarded as quite satisfactory by the vast majority of them.

Part-time Courses

Part-time courses in the colleges of commerce fall into two broad categories in that they lead either to the examinations of a relatively large number of professional bodies associated with such specialised and divergent branches of commerce as accountancy, company secretaryship, banking, insurance, shipping, transport, and the export trade, or to the National and Higher National Certificates in Commerce (p. 367).

Generally speaking, the professional courses are highly specialised, although at the Intermediate stage they do require a somewhat broader field of study than at the Final stage. The Ordinary National Certificate courses, on the other hand, aim at providing a broad, general commercial training; whilst those leading subsequently to the Higher National Certificate usually cover the requirements of specialised branches of commerce which have not, so far, become the pre-occupation of any professional examining body.

Professional Courses

The standing which the professional examining bodies (p. 194) have gained in the field of commercial education has an historical explanation. Bodies of business men associated together for their mutual advantage in professional organisations related to their own particular interests and undertook, as a matter of necessity, the task of setting up professional standards, which in turn led inevitably to their laying down courses of study which would be undertaken by young men seeking to enter the profession. From this it was but a short step to their setting up examinations by which the fitness of their clerks for professional membership could be ascertained.

The older professional bodies, such as the Institute of Chartered Accountants, still regulate the training of clerks articled to members of the Institute. But other bodies, such as the Chartered Institute of Secretaries, the Institute of Bankers, the Chartered Insurance Institute and the Institute of Transport, are much less rigid in their requirements and to-day, from the point of view of the average student, they are little more than examining bodies which, however, confer, in addition to distinctive letters, certain other privileges when the Associateship is awarded.

At the time when such schemes were being developed, few, if any, alternative courses of study were available to the more ambitious student. From the beginning of the present century, some universities had developed Faculties of Commerce and introduced the Degree of Bachelor of Commerce, but they catered only for the chosen few. For the vast majority of students who could not go to university, the professional courses were the only alternative. Thus when the colleges of commerce developed after the first world war, they found the professional bodies strongly entrenched and were compelled by public demand to introduce courses leading to their examinations. In England and Wales they had not the prestige which would have enabled them to establish recognised awards of their own. In Scotland, the single central college of commerce has fared rather better in this respect, its diplomas having gained national recognition. Nevertheless, here too a full range of professional courses is made available to students.

One great difficulty which all colleges of commerce have to face is the organisation of the multiplicity of classes required by the often unnecessary, and in many cases unreasonable, variations which occur in the syllabuses of the professional bodies, even where the same subject is concerned. An overwhelming case can be made out for a greater measure of standardisation of both subjects and syllabuses, at least at the Intermediate stage. Recently such a measure of standardisation was achieved at this level by the Chartered Institute of Secretaries and the Institute of Bankers, but much more remains to be done. As the number of such professional associations tends to increase, the problem of providing suitable courses to meet such varying requirements in the colleges becomes more difficult year by year.

In the United States such a problem does not arise. Owing to the size of the country, and its different historical background, coupled with the fact that the very large number of university business schools have taken charge of commercial education from the beginning, the student there, whether part-time or full-time, necessarily works for a university degree. Thus the professional examination, as we understand it, is non-existent in that country.

A tribute must be paid to the professional associations for the part which they have played in the task of developing commercial education in Great Britain. They have helped to establish national standards of achievement and have pioneered the development of many uncharted fields of business training. Much credit is theirs for the growing nation-wide appreciation of the value of education for commerce.

National Certificates in Commerce

National Certificate schemes in commerce were inaugurated in the thirties by the Ministry of Education in collaboration with the Association of British Chambers of Commerce. The course for the Ordinary National Certificate extended over three years of part-time study, and was designed to cover a broad unspecialised field of general commercial subjects. Colleges of commerce were permitted to formulate their own schemes of study, on general National Certificate lines (p. 154). In some areas of the country, the Regional Examining Unions (p. 146) took over the work of examining from the colleges.

Prior to the war, the scheme was not very successful. The professional bodies refused to co-operate in granting exemptions from their own examinations to students who had gained corresponding National Certificate successes, and, by and large, refused to grant any recognition whatsoever to the scheme. This was in marked contrast to the attitude of the professional bodies in the field of technical education (p. 194). As a result, such schemes as were planned for the development of a Higher National Certificate in Commerce failed to get beyond the blue print stage.

Since the war fresh efforts have been made to regenerate the National Certificate scheme. The Carr-Saunders Committee emphasised the need for 'general courses in commercial subjects, not designed as a first step towards proficiency in some particular commercial technique'. They suggested the inclusion, in the first year of such a course, of the history and geography of commerce, the structure of commerce, and mathematics as a basis for statistics. In the second year the elements of law, central and local government, accounting and statistics were recommended subjects, to be followed in the final year by a more advanced study of law, accounting and statistics, together with economics and geography 'with special relation to local commercial and industrial interests or possibly other selected subjects'.

At the Higher National Certificate stage the Committee agreed that more specialised vocational schemes were necessary and expressed the view that these could be oriented towards such areas of business activity as shipping, the various branches of distribution and the commercial side of industry which so far had not become the province of any specialised body. They also recommended a broadening of the Joint Committee supervising the National Certificate scheme by the inclusion of representatives of the professional organisations themselves.

Many of these suggestions have now been adopted. A new Joint Committee not only includes professional representatives, but also representatives from organised labour. One interesting development, however, has been the shortening of the ordinary National Certificate course from three to two years and a corresponding lengthening of the Higher course from two to three years.

EXAMPLE OF A SCHEME FOR THE
ORDINARY NATIONAL CERTIFICATE IN COMMERCE

		Hours per Week
Year 1		
Compulsory Subject	Structure of Commerce	1½
Elective Subjects	(three to be chosen)	
	Economic Geography	1½
	Statistics	1
	Accounting I	2
	Foreign Languages	2
Year 2		
Compulsory Subject	Economics	1½
Elective Subjects	Elements of Law	1½
	English	1
	Accounting II	2

HIGHER NATIONAL CERTIFICATE IN COMMERCE

Year 1	General Principles of Law	1½
	Economics	1½
	Accounting	2
Year 2	Commercial Law	1½
	Economics	1½
	Accounting	2
Year 3	Marketing	1½
	Accounting	2
	Export Practice or Costing	1½

This arrangement certainly helps to meet difficulties connected with the period of National Service at present required from young men; students commencing the course at sixteen years of age are enabled to obtain the Ordinary Certificate before being called up, and may then go forward to complete the course for the Higher National Certificate after having completed their period of National Service.

One difficulty which remains to be solved is that relating to the entrance requirement for National Certificate courses. The Carr-Saunders Report recommended, as a minimum requirement, a pass in English and in Mathematics at the ordinary level in the examination for the General Certificate of Education. The Ministry of Education (Rules 104) has modified this to 'a specified standard of education' which is being somewhat variously interpreted in different parts of the country. The problem is not easy. Insistence on a previous education to General Schools standard may make the Certificate more acceptable to the professional bodies, but would virtually eliminate from the course any student who had not attended a secondary grammar school. The secondary modern schoolboy would thus be excluded from any worth-while commercial course. Fortunately, at present it would appear that a considerable amount of discretion is being granted to the individual colleges so far as admission to the course is concerned.

In Scotland, the organisation of the National Certificate scheme is rather different. It is administered by a National Committee which includes representatives from education authorities, commerce and industry, the Educational Institute of Scotland, the Scottish Education Department and the Central Institutions. For purposes of administration, four regional committees have been established, viz. the North Regional Committee, with headquarters in Aberdeen; the Dundee Regional Committee, the Edinburgh and South-East Scotland Regional Committee and the Glasgow Regional Committee. These Committees foster the scheme by encouraging the establishment of classes, and arranging for the co-ordination of all classes within their respective areas, in association with local education authorities. In addition, the Glasgow Regional Committee has organised its own preparatory classes for students not sufficiently advanced to take the National Examinations, and awards Regional Certificates to those who are successful in the Regional Examinations.

The Scottish National scheme differs in several respects from those organised in England and Wales. A two-year course leads to a Junior National Certificate, but parallel to this course there are two others of similar duration, leading respectively to a Shorthand-Typist Certificate and a Clerk-Typist Certificate.

More advanced courses, extending over a further two years, lead respectively to a Senior National Certificate (from the Junior National Certificate stage) and a Secretarial Certificate (from the Shorthand-Typist Certificate stage). There are thus both junior and senior certificates in secretarial work as well as in general commercial studies.

Present Controversies

Much controversy at present rages as to the respective place and function of these varying schemes for part-time commercial courses. Whilst the professional bodies remain a law unto themselves, and so far, with one exception, have refused to recognise for purposes of partial exemption from their own examinations any success gained by a student in a National Certificate course, certain of them have, to a limited extent, made concessions to selected colleges of commerce. Such concessions, granted by the Chartered Institute of Secretaries, the Corporation of Secretaries and the Institute of Bankers in England involve the recognition, subject to assessment, of the examination in certain subjects, at the Intermediate stage, conducted by the colleges themselves. However limited such a gesture may be, it is at least a step in the right direction and links the colleges more closely with these professional bodies.

But whilst the professional societies still hold aloof from the National Certificate itself, at least three schools of opinion have grown up as to the place of this certificate in the scheme of part-time commercial education.

First of all, there are those who hold that all students should first of all complete the Ordinary National Certificate course. Thereafter, Higher National Certificate courses should be devised to cover the more specialised fields of the various professional bodies, exemption being granted by the latter for every corresponding subject passed in this Higher National Certificate examination.

A second school of thought regards this as an unwarrantable intrusion into the affairs of the professional societies, which the latter would never permit, though exemption might be granted in 'background' or 'non-specialised' subjects.

Finally, there is the view that the National Certificate in Commerce should stand on its own feet as a valuable qualification in itself; that no recognition should be sought from the professional bodies; that at the higher stage it should seek to cover areas of commercial activity not specially associated with any professional society; and that students debarred by lack of school examination success from taking a professional course should not be excluded from a National Certificate course.

Much of this confusion has been due to a failure to recognise that to attempt to create a single all-embracing National Certificate in Commerce is as unreasonable as to try to establish a National Certificate in Technology. Just as in the technological field, different National Certificate schemes have been developed to meet the specialised needs of students in the varying branches of science and engineering, so in the commercial field there is need for specialist courses in accountancy, cost accountancy, company secretarial work, transport, marketing, sales organisation and management, etc. Whilst there is much to be said for maintaining the present conception of an Ordinary National Certificate in Commerce as providing a preparatory and generalised background to more advanced and specialised studies, thereafter Higher National Certificates associated by name with the specialised fields suggested above should replace the present Higher National Certificate in Commerce. These would not only be more acceptable to the professional bodies, which would be able to consider the claims of a certificate associated by name as well as by content with their own particular spheres of interest, but would still enable fields of study not associated with such bodies to be suitably catered for. Such a development would go far to reconcile the conflicting views outlined above.

The cause of commercial education will best be served by fuller responsibility being placed with the colleges for the organisation of such courses to suit the particular, and often peculiar needs of their own immediate area. National Certificate courses are highly flexible from this standpoint. But where broad, specialised standards applicable to the whole country are concerned, the professional bodies are not only strongly entrenched, but are rightly jealous of the standards they safeguard. Specialised Higher National Certificate courses should, therefore, be developed as separate entities related to these specialised fields of study, and the standards reached should be such as to compel the professional associations to take account of them [3].

Management Studies

Unquestionably one of the most interesting post-war developments has been the introduction of so-called management studies into the sphere of commercial education.

Arising in the first place out of carefully designed courses of business training intended to equip (or re-equip) ex-servicemen for entry (or re-entry) into commercial life after the war, management training courses have now been initiated throughout

Great Britain as a means of ensuring a flow of trained junior executives from whose ranks the senior managements of the future may well be selected. The problems of succession trouble many firms to-day, as the war caused an inevitable gap not only in the ranks of the younger generation of promising executives, but in the training and experience which they would normally have received.

The intensive training in management techniques of carefully selected young men with varied backgrounds of education and experience is at least one answer to the problem. But the growing interest shown by business firms in this new field of educational endeavour has been powerfully reinforced from another direction. This is a growing awareness that the deterioration in the economic position of this country as a result of the war has made a real increase in the nation's productivity absolutely essential, and the vital part to be played by management in the years ahead to attain this goal is more generally realised. The reports of productivity teams which visited the United States, especially that on Education for Management, stress the importance of the specialised education made available there to young business men as a major factor contributing to the high productivity of American industry [4]. In this country, the British Institute of Management (B.I.M.) has been established and curricula leading to an Intermediate Certificate and to a Diploma in Management Studies have been developed (p. 211). The Institute of Industrial Administration, which for long has pioneered management studies in this country, has become the professional wing of this new Institute of Management.

The course for the common Intermediate Examination of the British Institute of Management includes, as introductory subjects, the Evolution of Modern Industrial Organisation and the Nature of Management. As background subjects, the Economic, Legal and Psychological Aspects of Industry and Commerce are studied, whilst as tools of management the course includes financial and cost accounting, statistical method, work measurement and incentives and office organisation and method. Whilst such a course embodies subjects generally included in most commercial courses of instruction, their treatment has been developed from rather a different standpoint.

At the diploma stage, the principles and practice of management are studied at a more advanced level, whilst other studies may include many specialised aspects of management in the fields of general management, office management, personnel management, works management or purchasing management; these are associated with, and examined by specialised professional associations such as the Institute of Industrial Administration, the Institute of Personnel Management, the Institute of Works Managers, the Purchasing Officers Association and the Office Management Association. Variations on this general theme apply in the case of certain larger colleges, such as the Colleges of Technology at Manchester, Birmingham and Leicester, and also the specialist Glasgow School of Management Studies (operated jointly by the Royal Technical College, Glasgow, and the Glasgow and West of Scotland Commercial College). A number of changes in the arrangements for the Award of Diplomas in Management Studies have recently been agreed between the B.I.M. and the Ministry of Education [9].

The last few years have also seen the development of a variety of experiments in management training, some of a specialised character, though the total volume of activity represented by these is still pitifully small. Probably the most ambitious and the most successful of these experiments in training for general management is represented by the Administrative Staff College at Henley-on-Thames (p. 188). This venture which, in the course of a twelve weeks' period of full-time residence, encourages men and women of mature age and considerable experience to educate one another, has attracted widespread interest not only in the United Kingdom, but in many other countries. Some of the leading American centres of management education have paid the College the compliment of sending observers to study its methods.

This idea of a residential administrative staff college is being copied in a number of industries. Thus the nationalised industries have either actually set up such establishments as the British Railway's Staff College, or have plans under active consideration, as recently announced by the National Coal Board. Again, starting in 1948, the Midland Bank has been running residential courses for managers and potential managers in a country house in Surrey. The course for managers is a short one of 10 days; that for those who have not yet attained managerial status lasts for 10 weeks. Unilever and other industrial firms have done the same thing. Residential courses in this category, unlike those at Henley, have a strong bias towards the special problems of the business or of the industry concerned. Another example in a more specialised field is the training in production management provided by the College of Aeronautics at Cranfield.

The idea that experienced managers of senior status can benefit from 'refresher' courses, although widely accepted in the United States, finds only limited approval here. Nevertheless some interesting pioneering work on a limited scale has been done. For a number of years the Manchester College of Technology has run a discussion group limited to senior executives, dealing with problems of current interest to top management. Out of this has come the well-known series of Monographs on Higher Management. The Birmingham College of Technology has conducted a series of Lecture-Discussion Courses for directors and senior management, and has also provided facilities for co-operative Senior Management Discussion Groups; and the Glasgow and West of Scotland Commercial College offers a Senior Management Study Group working on the basis of lectures and group discussion.

The important field of personnel management is being catered for by two methods of approach. In London, Manchester, Glasgow and Cardiff, a one-year course of full-time study is offered in association with the Institute of Personnel Management. The course is open only to graduates or to persons of mature age with industrial experience, and candidates are carefully selected by an interviewing panel. Theoretical instruction is combined with short periods of practical work in industry. In addition, some centres offer short courses which are usually part-time in character.

In many respects the provision of courses for foremen and supervisors is the most neglected part of management education, and presents some really formidable problems on which much hard thinking will be necessary. This unsatisfactory state of affairs in part stems from the anomalous position of the foreman in industry. The most advanced development in this field is to be found in the Leicester College of Technology and Commerce with a residential course of three weeks' duration. This is supplemented by a week-end refresher course. A number of colleges provide courses of varying duration on a part-time evening basis, the most popular course being that for the I.I.A. Certificate in Foremanship covering two years. In certain cases, special courses have been devised to meet the needs of particular trades, as for example, under the auspices of the National Federation of Building Trades Employers (p. 296). Other examples are the Furniture Trade Foremanship Course offered by the Enfield Technical College and a course for Mine Deputies provided at Barnsley Technical College. Supplementing all this work, a considerable amount of training of foremen is taking place within industry with some assistance from college staffs.

The introduction by firms and organisations of their own management training schemes, whether at foreman level or higher, raises some interesting questions. Such 'internal' training enables the staff to be familiarised with company policy and practice, which is obviously very important. But it opens up the danger of an uncritical approach to management problems—a danger which is reduced when trainees are brought up against the opinions and criticisms of people who have a different background. This benefit is one which can be secured from specialist educational institutions. This view does not imply, however, that no training should be undertaken by the firm, but that sole reliance should not be placed upon it.

Another specialist field to which a great deal of attention has been paid is that of Work Study and Methods Engineering. Prominent in this connection has been the course provided by the Acton Technical College covering four weeks of full-time study. Other well-known courses are those at Birmingham, Leicester and Luton. The Glasgow Royal Technical College has undertaken a course in association with the Scottish Council consisting of three weeks' full-time study followed by nine weeks' directed training at the student's factory. A danger latent in this type of study at the smaller centres is that undue emphasis may be laid on certain techniques, and that the wider setting of management training may be neglected.

An aspect of management training which has attracted increasing interest in recent years is that connected with the trade unions (p. 189). In part, this training is designed to help trade union representatives to perform their traditional functions more effectively and is consequently concerned primarily with the techniques of communication, the background and methods of industrial relations, and similar topics. To a lesser extent it is designed to promote the object set out in the T.U.C. Report on Trade Unions and Productivity—to ensure that trade union organisers 'should be equally as competent as the industrial consultants and technicians employed by management'. In this connection, the Birmingham College of Technology has a four-week full-time course of a residential type for Workpeople's Representatives. Other courses, often in conjunction with the trade unions, are held at Glasgow, Leicester, Manchester and Nottingham.

This variety of experiment in the field of education for management is based on the realisation of a very important fact.

Part-time courses of evening study tend, in the nature of things, to concentrate on the acquisition of factual information. But the art of management depends not only on knowing the right things but also on how to apply that knowledge, and to a great extent, facility in application must come from practical experience on the job. To leave this matter to solve itself can in many cases be dangerous. The trainee keeps 'theory' and 'practice' in separate compartments and fails to achieve a synthesis of the two. Day-release courses and courses of full-time study, when handled by the right people, can prevent such a fatal divorce between theory and practice.

The increased interest in management studies has already caused many of the leading professional associations to modify their examination requirements. But unfortunately largely because of a failure to reach agreement with the British Institute of Management, which has sought to secure the co-operation of these bodies in an effort to standardise and correlate management studies throughout the country, the introduction of this training has, so far, occurred in a haphazard manner from a national point of view. For example, whereas the Chartered Institute of Secretaries has encouraged management studies by introducing a Management Diploma as a post-graduate qualification, the Institute of Cost and Works Accountants has introduced such management subjects at the level of both its Intermediate and Final Examinations. The Incorporated Sales Managers' Association, on the other hand, has included these subjects entirely at the Qualifying stage. Thus considerable confusion exists at present as to the stage at which such subjects should be introduced into professional courses, and this has not made the task of the colleges any easier. Much of the more advanced work in commercial education to-day involves the preparation of students for the examinations of the various professional bodies, and a profound influence has therefore been brought to bear on the content of such courses of instruction by the growing interest in the work of training to-morrow's managers. It is very much to be hoped that future efforts of the British Institute of Management to secure a greater degree of correlation of work and standards in the professional field will be successful.

A striking characteristic of the educational system of the United States of America is the prominence of the University Business Schools [5]. Their existence underlines the view, widely held in that country, that the productive process is complete only when the finished product has reached the hands of the final consumer, and that in this productive process cost reductions brought about by efficient management do not apply only in the factory or workshop, but throughout the entire organisation. This in turn has resulted in a widely-held belief that a technological training alone is insufficient for men who will ultimately occupy the higher positions on the management ladder; that their outlook should be widened, and that an overall knowledge of every aspect of the organisation and administration of the business concern with which they may be connected is fundamentally desirable.

In Great Britain, on the other hand, we still tend to rely on our technologies. This is partly due to our industrial and commercial history; for more than a century, with markets readily assured us, it was the goods produced that had significance. Market research and the development of selling techniques were regarded as matters of secondary importance. From the management angle, the basis of productive effort was the relatively small firm, and management itself was regarded solely or largely as a function of the capacity and personality of the individual employer.

Ideas die hard, and even to-day there are far too many employers who think primarily in terms of the drawing office and the shop floor rather than in those of the organisation as a whole, including administrative and distributive departments. Such ideas have also been reflected in the Ministry of Education Circular No. 245, which expressly excludes commercial colleges and departments, vitally concerned though they are with many different forms of management training, from the list of institutions which may expand their facilities for technical education at the present time. Once again, the emphasis is purely on technological achievement at the expense of administrative efficiency, the development of management techniques, and scientific sales promotion, both at home and abroad. And this general attitude is also affecting management training itself in this country, much greater emphasis being laid on technological aspects of management than on business or commercial aspects.

There are, however, signs that the country is awakening to the value of the immense volume of commercial and management training which has now become such an important part of the American educational system, if only because our very existence depends on our being able to compete with business firms across the Atlantic both in overseas markets and especially in their own dollar markets. Sooner or later more emphasis must be placed on the adequate training of our younger executives in the field of commercial management, including sales management, as well as in the complementary field of industrial management.

Modern Foreign Languages

In the commercial colleges the considerable volume of work done in teaching modern languages should not be overlooked. The work falls into two parts. So far as French, German and Spanish are concerned, the colleges generally carry on where the school has left off and provide classes in the written and spoken language up to the standard, in some cases, of a university degree. In the case of such languages as Russian, Dutch, Polish, Norwegian, Swedish and Italian, full courses are organised in the larger colleges, which do not involve any previous knowledge of the language.

The teaching is generally oriented towards the commercial and economic side of the languages, but the main aim is always to train the student to speak freely and idiomatically. The teaching staff usually consists of teachers native to the country concerned, or honours graduates who have had periods of residence abroad. In Glasgow, the Commercial College is closely linked with the University, the Chairs of Italian and Spanish being jointly held in each institution. Teaching methods to-day include the use of the tape recorder (it is sometimes a chastening experience for a student to hear his voice played back to him, whether in English or in a foreign language), the film and film strip, and, more important still, the teaching is increasingly becoming supplemented by vacation trips abroad, often organised by the colleges themselves.

The importance of language teaching in this country can scarcely be over-estimated at the present time. The Goodenough Report merely underlined the obvious when it stressed its importance in the vital task of increasing our export trade. Far too many British firms still send men abroad with no knowledge, or at best with an imperfect knowledge, of the language of the country concerned. Many cases have occurred where even catalogues and other sales pamphlets, written entirely in English, have been sent abroad, occasionally with prices quoted in sterling. This apparent complaisance of many business men can only be explained, if at all, in terms of a century-old tradition of sellers' markets, in which British goods were eagerly awaited by the world because they were the best to be had and, of course, because they were British.

Such an attitude will get us nowhere to-day. The great need in this country is to take numbers of our highly trained graduates in modern languages and provide them, in the exporting firm itself, with an adequate knowledge of the product and, if necessary, its manufacturing processes. At the same time, the colleges of commerce should provide them with a general background of business knowledge, including some training in market research and selling techniques. In this way we could send abroad each year numbers of young and enthusiastic commercial ambassadors of the highest quality. Nothing would do more to ensure to this country a greater share of the world's available markets and to counteract American sales pressure which is spearheaded all over the world to-day by just such a highly trained sales force.

Schools of Librarianship

The first full time School was established in London University in 1919 for post-graduate students to take the University Diploma in Librarianship. Since 1946 full-time Schools have been established in the following colleges: Birmingham College of Commerce; Brighton Technical College; Scottish College of Commerce, Glasgow; Spring Grove Polytechnic, Isleworth; Leeds College of Commerce; N.W. Polytechnic, London; Loughborough College of Technology; Manchester College of Technology; Newcastle College of Commerce.

Students at the technical colleges are prepared for the Registration examination of the Library Association, qualifying for the Associateship—A.L.A., and for the Final examination, after which election to the Fellowship—F.L.A., may be achieved. Students may also prepare for these examinations in evening courses at these colleges, but the Library Association lays great stress on full-time professional education, and in future, professional staffs of libraries will probably come increasingly through the full-time schools.

Other Miscellaneous Courses

Reference must be made to the great variety of *ad hoc* courses which have been arranged to meet the special needs of given areas, and also to other courses which by tradition have become associated with colleges of commerce.

As examples of the first may be cited courses in port working and administration, and in shipping and forwarding, which are to be found in the colleges in London, Liverpool, Manchester and Glasgow, whilst export trade is dealt with in great detail to-day in most colleges associated with an industrial and commercial area. Other specialised courses in such various subjects as mechanised accountancy, conveyancing, speech training, public speaking and journalism are not uncommon. Nor must the volume of teaching aimed at the preparation of students for various examinations of the Civil Service Commission be overlooked. Both full-time as well as part-time evening courses have been developed according to requirements in different parts of the country. These prepare students for entry to the Executive and Clerical Classes in the Civil Service as also to such branches as the Post Office and the Customs and Excise Service. Wherever the need arises, efforts are made to meet it. In this and other ways the colleges of commerce stand ready to ensure that no legitimate educational need shall go uncatered for in their own particular regions of the country.

The American Business Schools

One of the most striking phenomena in the American educational system is the importance which is attached to business education. There are no fewer than 617 collegiate schools of business conferring degrees in business administration or commercial science, and some 155 of these are of university rank (but note p. 459) [6]. In 1950, no fewer than 75,506 such degrees were awarded, representing 11% of all degrees earned in that year.

The study of commercial subjects in the United States begins in the high school. It is continued at the universities in either four-year undergraduate courses, or two-year graduate courses for students who have taken their first degrees in other faculties such as liberal arts, science or in technology. Almost all universities run degree courses in evening classes for the benefit of men and women who have already entered business. The writer himself was recently present at such an evening course held in the University of Chicago where more than 100 students of over 30 years of age, many of them holding responsible positions, were completing the third year of their course for the degree of Master of Business Administration.

There is at present a tendency to develop the graduate business school at the expense of undergraduate courses, which means that increasing numbers of students will come to regard a six-year university course as normal. Graduation in a collegiate school of business is rapidly becoming a normal thing in the United States for men who hope to attain high executive or administrative rank in American business and industry. As the President of a large corporation said to the writer, 'A man who has not been to "school" suffers from a real handicap to-day.' How has this state of affairs come about?

Primarily because, from the outset, the schools of business have not only set out to integrate their courses with practical business experience in the commercial or industrial firm, but they have also secured the live interest and assistance of the men who run big business. The first objective has been gained partly by the development of co-operative schemes (sandwich courses, p. 86), by which men and women may spend equal amounts of time in college and with the business firms, and partly by the American tradition of students working their way through college. The second objective has been achieved by utilising the services on the staff of the colleges of business leaders (as distinct from business employees) who devote several hours a week either to lecturing or leading discussion groups. Such men are proud to become 'adjunct professors' of the university, a distinction which confers considerable status in business circles. Where such men have become keenly interested in their educational work, they have often become full-time members of the university 'faculty', retaining, however, certain of their business interests either as directors or expert advisors. Hence it is common for business firms to seek the guidance of such members of the university staffs on matters on which they are highly experienced. This, in turn, enhances still further the prestige of the business schools.

The stage has now been reached where a high proportion of American business leaders are graduates of these schools. Not only do they send their own sons to 'school', but they naturally lay emphasis on the possession of a similar background by the men whom they employ or promote. In this sense the wheel has turned full circle, and a tradition has been established which will continue into the future.

In America, business is the 'number one' profession and the universities have taken care to ensure that they play their full part in providing the necessary education and training as a preparation for this profession. From such outstanding universities as Harvard, Yale, Cornell, Stanford, Columbia, New York, North-Western and Chicago, right through the hierarchy of the American collegiate system, the provision of business and administrative training to the highest levels has become a most important part of the education of the young American. In our own educational pattern a similar development is needed in universities and major technical institutions alike.

Teaching Methods

One of the most interesting developments in commercial and management education which has occurred since the war in this country is the gradual introduction of new and often novel teaching methods.

Primarily, there is a growing interest in the use of the case study method which, originally developed at Harvard, has spread to most other university business schools in the United States. A case study may be a condensed account of a business situation, or a series of connected situations, prepared by an expert panel of investigators usually acting on the invitation of a commercial or industrial firm which is willing to co-operate in its preparation. Much time may be spent on the investigation; the Harvard Business School, for example, spends many thousands of dollars annually on the preparation of case studies. Such studies may, however, be prepared in a variety of ways. The final draft of the study is ultimately placed in the hands of a group of students, who are given a certain period of time to consider it individually and later to discuss its implications collectively. Thereafter, the group suggests a suitable course of action to be taken by the management in dealing with the problems involved.

In this country, many colleges are now beginning to introduce this method of instruction to supplement the lecture method of teaching, particularly where more advanced studies are concerned, and certain major colleges are now beginning to produce their own case studies in close collaboration with local firms. Such studies are not only typed or printed, but are recorded on machines or on film strips and, on occasion, on sound films. Similarly, other forms of discussion group technique as a method of teaching have been evolved and are being introduced into the class room when they are relevant. Such variations in teaching method provide a welcome change for the student and often secure his enthusiastic co-operation in discussion, instead of his function being limited in the lecture room to that of acting as a silent absorber of knowledge provided by his teacher.

The growing interest in these new techniques has perforce led to a greater rapprochement between the commercial colleges and business firms. At no previous time has there been so much co-operation by firms, in receiving students on visits, accepting them for training during college vacations, and facilitating the attendance of senior members of their staffs at discussion groups in the colleges. It is a hopeful augury for the future that already many colleges in this country are beginning to experience that happy liaison with business undertakings, which is such a pronounced feature of the university schools of business in the United States.

From another point of view, teaching techniques have been influenced by a recognition in recent years that young men and women in our centres of further education constitute, as Messrs. Dobson and Young have been at pains to point out, a highly critical audience, conditioned as they are to radio, television and the cinema, which put across their material with streamlined efficiency. The younger generation is not unnaturally critical of 'chalk and talk' and above all of the laborious process of writing down dictated notes, which is still a characteristic of too many of our more venerable educational institutions (p. 543). Many experiments are now being made in the use of such aids as the film, the film strip and the tape recorder. Again, the practice of providing the student with a duplicated précis of the material with which the lecturer concerned proposes to deal in class, is growing, albeit slowly, with advantages to both lecturer and student too obvious to be laboured.

Staffing of Commercial Colleges

Full-time members of staff are generally recruited in much the same way as in the case of secondary schools, from the ranks of university graduates. Graduates in commerce or economics are usually employed to teach in the more specialised fields of accountancy, commerce, economics and related subjects, whilst legal subjects are, where possible, placed in the charge of graduates in law, or such professionally qualified men as solicitors or barristers, who prefer an academic life to professional practice. Specialists with appropriate degrees usually teach such subjects as English, foreign languages, history and geography.

Much controversy exists as to the desirability of actual business experience as a contributory qualification for teachers of commerce, but the contestants rarely define the terms of their arguments in this connection. If, when speaking of the commercial teacher, they include the specialist teacher of English or French or Spanish or German or history or geography, then it is difficult to see what advantage their possession of commercial experience would have for either the teacher or his students. Much the same applies to the specialist teacher of economics. Where, however, business experience is vital is in the teaching of Commerce and Commercial Practice and those other subjects which are largely concerned with the day-to-day activities of the business world. But this is a very different thing from saying that all members of the staffs of commercial colleges should have had business experience.

But even where such experience is desirable, it is not easy to obtain it. A young graduate attracted to teaching, who wisely decides to spend two or three years in business before taking up a teaching career, will find that he loses seniority, and incurs a probable reduction in the size of his pension on retirement, by postponing his entry for a year or two into the profession. On the other hand, if he delays still further such an entry, he may well create a suspicion that his desire to take up teaching is not unconnected with a possible failure to succeed in the business world.

The question of professional training is also one which needs consideration. Prior to the war, there were few professionally trained commercial teachers, and these consisted largely of university graduates in commerce or economics who had voluntarily taken a post-graduate course of training, which was rarely of a specialised character. An interesting development has taken place in England since the war, however, in the establishment of three training colleges for commercial teachers (Chapter XVIII).

Scotland has for many years insisted upon a specialised training for its commercial teachers. Apart from graduates in commerce or economics of the Scottish Universities, almost all commercial teachers in the country have passed through the Commercial Teachers' Diploma Course in the Scottish College of Commerce, Glasgow. This course extends over three sessions, and students are required to spend at least six months with selected business firms who co-operate with the College in ensuring that they obtain a varied experience during their period of practical training. After completing their course of study, the diplomates of the College spend a further year at a training college for teachers before taking up work in secondary schools or centres of further education. Recently the College has introduced an alternative course extending over four sessions for students anxious to qualify for senior work in commercial education in Scotland. In this case, an additional six months of practical experience is required.

The great bulk of commercial teaching in Great Britain, however, still remains in the hands of part-time members of staff who lecture in evening classes at the end of a day's work in commerce or industry or in professional employment.

Here, the question of practical experience does not arise, but the equally important question of their capacity to teach does. Fortunately, after a period of trial and error, many such teachers do, in fact, settle down and prove their worth over and over again. But there are many failures, and these cannot always be replaced at a time when the already small remuneration they get for their efforts is virtually halved by income tax demands. This situation puts a very high premium on enthusiasm for teaching. It also may be doubly disastrous, as it may make inevitable the employment of some men who frankly admit that 'they wouldn't be there if they didn't need the money', and it may make available for employment in this way only those men who do need the money because they have failed to secure adequate promotion in their own profession or employment (Chapter XVIII).

One of the most pressing problems is that of the status of leading commercial colleges in Britain, when compared to that possessed by the university schools of business in America (p. 380). Only when their status has been nationally recognised will the right kind of teaching assistance be readily forthcoming from industry and commerce (Chapter XV).

Commercial Education in the Future

What of the future of commercial education? The one thing that remains a vital need is that education for business should be integrated much more fully than at present into the educational pattern of this country. There are many reasons for this.

First of all, the constant development and ever-greater complexity of many commercial subjects is out-growing the capacity of the part-time evening class. This is particularly so in the field of accountancy. In the near future the relevant professional associations will have to face this problem. The part-time day class is thus the inevitable successor to the evening class (Chapter IV).

Secondly, to give young men the knowledge which is now generally admitted to be an essential part of their equipment as business executives of the future, full-time courses in the colleges of commerce will become indispensable (Chapter III). Sooner or later—and the operative word is the first one—we must do something to equal the tremendous volume of effort in business education which is now a characteristic of the United States economy (in terms of relative populations), if we are to continue to be a serious competitor both in dollar and sterling markets.

Thirdly, the educational system of this country, excluding the science side of the secondary school, is still largely influenced by the age-old classical tradition, a type of education possibly suitable for a wealthy country when it was the commercial and industrial centre of the world, but which is no longer appropriate to a nation with its sleeves rolled up, fighting for its very economic existence. Change, though slow, is now quite inevitable.

And finally, it is through education and training designed to create the necessary capacity for executive and administrative leadership, based on the necessary 'know-how', that the future of this country will largely depend. Wisdom, which comes from a broad education and a wide experience of life, is as vital as ever at both the personal and national level; but it must nevertheless be widely understood that the business executive of the future will need a good knowledge of accountancy, of the relevance and reliability of statistics, of the scientific principles of management, and to be expert in human relations, if he is to measure up to world competition. The British way of life will be undermined if management fails to play its part in ensuring a reasonable standard of life throughout this present economic revolution. As signs of the times, trade unions are increasingly impatient with inefficient managements, and many prominent industrialists now agree that many of the sins so often ascribed to inefficient organised labour should in reality be laid at the door of inefficient management.

No one pretends that theoretical instruction for business is any substitute for practical business experience. What business education can do is to shorten the path to business efficiency by equipping the young man or woman with valuable tools of knowledge and techniques, and also by making them aware of the problems which will face them. The creation of this awareness and a *potential* business acumen *and* human understanding in students is the critical task and opportunity of management education to-day.

In the coming years the colleges of commerce, as distinct, in this case, from the commercial departments of technical colleges, must necessarily develop into national institutions of great significance. The universities in this country are not the appropriate bodies to undertake such work [7]. Their outlook and traditions are very different from those of the universities in the United States, and many of them which attempted to provide commercial education have now abdicated from this field of endeavour. Within the last few years both the Universities of Aberdeen and Manchester have abolished their Faculties of Commerce, whilst London has similarly withdrawn its Commerce degree.

But in order that the colleges of commerce in England and Wales may be put into a position to undertake the tasks which lie ahead, the first requirement is regional organisation. Each college must draw its students from a wider area, with the full co-operation of the local education authorities involved. Financial assistance, where necessary, must be provided on an adequate scale, both for the college itself and for the students attending it (Chapters XV, XVI).

Again, at national level, full recognition must be accorded to the colleges. They must be given every assistance to help them to ensure that the diplomas they award become as widely recognised in the country as is the degree of a university. This can only be done by seeing that buildings are both adequate and functionally designed (at least one leading college of commerce in this country is housed in an abandoned teachers' training college), and that staffing standards and ratios are generously revised. In particular, adequate payments attractive to high business executives should be authorised, where their knowledge and skill makes it desirable that the college should utilise their services on a part-time basis. Given these conditions, the colleges can become fully integrated into the business world with two-way traffic no longer a chimera, but a reality.

Commercial education is a comparative newcomer to the field of education. To-day it is a Cinderella. A generation of business men may have to pass before its value and significance are fully appreciated and recognised.

It may not be inappropriate to conclude this chapter with a quotation from Rousseau. 'When I see the studies of young men at the period of their greatest activity confined to purely speculative matters, while later on they are suddenly plunged, without any sort of experience, into the world of men and affairs, it strikes me as contrary alike to reason and to nature, and I cease to be surprised that so few men know what to do. How strange a choice to teach us so many useless things, while the art of doing is never touched upon' [8].

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CHAPTER XIII

OTHER TECHNOLOGIES AND CRAFTS

There are important industries, some employing large numbers such as mining and textiles, which are not widely and evenly dispersed, but occur only in particular regions and are therefore connected with a minority of colleges. Agriculture is an exception, and is of such prime importance that it rightly requires a book to itself (p. 13), but here can be treated only by way of reference.

Other groups are very limited in scope and employment, but are nevertheless very important. They may be widely dispersed in small groups or dispersed as special techniques throughout many industries, so that multiple provision cannot reasonably be made. For these reasons have been established the national colleges for particular technologies each with the following aims and requirements; to provide highly specialised training for a single industry, including post-graduate courses and research; to be governed by the industry itself through a representative governing body with ample freedom to put industry's ideas into practice; to be financed by the State but with substantial assistance from industry; to draw its students preferably from the ranks of industry [1]. The present work of these colleges is outlined, and their full-time enrolments are given in Appendix, p. 603.

The establishment of seven of these national colleges constitutes a major post-war development of higher technological education and arose from the Percy Committee Report (p. 470) [2] and the Ministry's Circular 98 (p. 484) [3]. In this period too, the conditions of governance of the Royal College of Art have been changed to those of a largely self-governing institution, a change with immense possibilities [4].

The broad distinctions to be made between craft, techniques and technology are discussed later (p. 447), but here is given factual information of the present educational provision for a wide variety of subjects chosen for their economic importance, intrinsic interest or future possibilities. Those who require further details are strongly advised to obtain the pamphlets published by the professional institutions; by the Central Youth Employment Executive (C.Y.E.E.), the Ministry of Labour and National Service (M.L.N.S.), the Anglo-American

Council on Productivity (A.A.C.P.), and the Association of Technical Institutions (A.T.I.). Attention is drawn specially to The Ministry of Education Pamphlet, No. 8, pp. 90–176, Appendix I: Examples of Special Educational Facilities for Certain Occupations (H.M.S.O., 1947).

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LIST OF SUBJECTS

Subject	*Page*
Aeronautics	392
Agriculture	393
Bakery and Confectionery	394
Boot and Shoe Technology	396
Ceramics	397
Chemical Engineering	398
Clothing Technology	400
Coal Mining	401
Food Technology	403
Foundry Technology	404
Fuel Technology	405
Furniture and Timber Technology	406
Gas Engineering	407
Heating and Ventilating and Refrigeration Engineering	408
Horology	409
Horticulture	410
Leather Technology	411
Marine Engineering	412
Naval Architecture	413
Navigation and Nautical Courses	414
Oil Technology	415
Paper Technology	416
Pigments, Paints and Varnishes	416
Plastics	417
Printing	418
Rubber Technology	420
Textiles	421

Aeronautics

This section does not cover the extensive R.A.F. Service Establishments, but only civilian needs, which have been catered for in the establishment early in 1946 of the College of Aeronautics, Cranfield. A high grade engineering, technical and scientific training in aeronautics prepares students for important positions in the aircraft industry, civil aviation, education and research. The College is financed through the vote of the Ministry of Education but the policy control is in the hands of a Board of Governors, appointed by the Minister and representing a wide range of aeronautical interests. Detailed control is in the hands of a Senate consisting of the Principal and Heads of the teaching departments.

The work is organised in four main departments; aerodynamics, aircraft design, aircraft economics and production, and aircraft propulsion, and the two-year full-time residential course at post-graduate level includes a thesis based on some experimental research or on undertaking a piece of design work, and leads to the Diploma of the College (D.C.Ae). Students are in three main groups, those with primarily a university background, those with an industrial apprenticeship and a degree or a Higher National Certificate, and Officers from the Royal Navy and R.A.F. The College handbook states that 'The original policy not to insist on a degree as a necessary qualification of entry, despite the post-graduate nature of the course, has been thoroughly justified'.

Intensive short courses of about two weeks' duration are frequently held for special subjects (245 students attended ten such courses in 1953–4); and research is encouraged in every possible way. As a contributory link with the main post-graduate work of the College, it should be noted that with H.N.C. in Mechanical Engineering a student can gain an endorsement in Aeronautical Engineering countersigned by the Royal Aeronautical Society (p. 156).

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Agriculture

Responsibility for agricultural education lies with the Local Authorities and the Ministry of Education, and for advice to those engaged in any branch of the agricultural industry with the Ministry of Agriculture and Fisheries through the National Agricultural Advisory Service. This administrative dichotomy is the subject of sharp controversy.

Careers in agriculture include practical farming, inspection and advisory work, marketing and supply services, teaching and research, for both men and women. With increasing mechanisation and the growth of special services, physical strength counts for less and less and opportunities for women have increased correspondingly. This increasing mechanisation is but one aspect of the growing application of science to farming which makes a good standard of education increasingly necessary.

An indispensable love of the country (in all weathers), good health and physique should be put to the test of at least a year's practical experience on a farm before detailed training is undertaken and this most certainly for someone from a town. For practical farming a one year's course at a farm institute is normally considered sufficient, but some with the necessary entry qualifications take a diploma at an agricultural college or a degree at a university, especially if they intend to farm or manage estates on a large scale. Subsequent practical experience of a varied character and at different levels of responsibility is most important. Good practical experience and high educational qualifications are essential for inspection and advisory work and for teaching, and personality and tact are no less important. Apart from degrees, the recognised national qualification is the National Diploma in Agriculture (N.D.A.), awarded on examinations conducted by the National Agricultural Examinations Board. Most colleges have their own diplomas, but prepare students for the N.D.A. also. Like students attending urban technical colleges, students wishing to attend agricultural colleges may apply to their Local Authorities for financial assistance in accordance with parents' income, or they may gain scholarships which are offered by universities and many of the colleges.

REFERENCES

The Education of the Countryman, H. M. Burton (Kegan Paul, 1943).

Growth in English Education, p. 150, H. C. Dent (Routledge, 1954).

Ministry of Education Pamphlet No. 3, *Youth's Opportunity*, Chapter XI—The Special Needs of Rural Areas (H.M.S.O., 1945), also Pamphlet No. 8, *Further Education*, e.g. pp. 137–46, 160–4, 206–9.

Report of the Working Party on Agricultural Education (H.M.S.O., 1953).

'Agricultural Education', *Nature*, April 17th, 1954, p. 705.

M.L.N.S., *Choice of Careers*, Pamphlet No. 3, gives details of university and college courses.

Skill in Country Workshops, by Rural Industries Bureau (p. 617).

The Royal Agricultural Society of England (p. 617).

The Royal Highland and Agricultural Society of Scotland (p. 617).

Institute of British Agricultural Engineers (p. 617).

The National Agricultural Examinations Board (p. 617).

Bakery and Confectionery

This trade has been practised since ancient times and is carried on in every town, if not in every village. Like other trades and crafts it has undergone far-reaching changes in character and organisation, especially with the increasing spread of mass production in the last few decades. This has been accompanied, even if it has not been stimulated by the increase of educational facilities, which are now established in

84 technical institutions, mostly part-time day and evening courses for City and Guilds Examinations.

Two or three-year full-time courses are held at Birmingham, Blackpool, Cambridge, Cardiff, Leeds, Liverpool, London (the Borough Polytechnic), Manchester, Southampton, Plymouth, and a three-year sandwich course (with industrial experience) is being established at Salford. Two-year full-time courses normally lead to the National Diploma (N.D.) and three-year courses to the Higher National Diploma (H.N.D.). Both these Diplomas are awards on courses recognised by the National Board for Bakery Education, which was set up in 1947 to act in place of the National Bakery Education Advisory Committee of the National Master Bakers' Association.

Bakery education is stimulated by the work of ten regional Bakery Education Advisory Committees (B.E.A.C.), and also by the Baking Industry Joint Scholarship Scheme established through the close co-operation between the National Board for Bakery Education and the National Association of Master Bakers, Confectioners and Caterers and the goodwill of the Trade [1]. This offers several scholarships of maximum value of £200 per annum for students taking an H.N.D. course, and other scholarships for students taking the N.D. course.

Recently there has been much controversy over the number of students taking different types of courses. A recent survey [2] shows that 2,026 students (32·5% of all in attendance) take courses but no examinations, 2,956 (47·5%) are in City and Guilds Intermediate courses, 845 (13·6%) in the City and Guilds Final courses, 138 (2·2%) in City and Guilds Full Technological Certificate courses; there are 251 (4%) in full-time National Diploma and 0·06% only in Higher National Diploma courses. Concern has been expressed at the lack of support for bakery courses which is affecting recruitment to the industry in some areas, and the National Board for Bakery Education has emphasised that recruitment is the responsibility of the industry; educational authorities could only supply the necessary facilities [3].

REFERENCES

1. The National Board for Bakery Education (p. 617) which will supply details of the Joint Scholarship Scheme.
2. James Hall, 'Trade Education Is Not Perfect, But—', *Bakers' Review*, 30th April, 1954.
3. Reported *Times Educ. Suppt.*, 30th July, 1954.

British Baking Industries Research Association (p. 621).

Boot and Shoe Technology

The manufacture of boots and shoes is highly localised, mostly in Leicestershire, Northamptonshire and nearby towns, but also in Stafford, Lancashire and Kilmarnock and Arbroath. The colleges at Leicester, Northampton and Norwich have established departments of Boot and Shoe Manufacture. At Northampton there is a two-year full-time course leading to City and Guilds Examinations and one is offered at Norwich. At Leicester there is a one-year full-time course in General Shoe Technology; another in Foremanship Course of Advanced Technology, which leads to the Graduateship examinations of the British Boot and Shoe Institution (B.B.S.I.); and a Management Course for Associates of the B.B.S.I. or others equally qualified, which covers all aspects of general management. The three courses may be taken *seriatim* to gain a college diploma. A course for prospective shoe designers is provided in conjunction with the College of Art Departments of Dress and Industrial Design and leads to the Ministry of Education National Diploma in Design. The foregoing courses (except National Diploma in Design) are held at the Cordwainers' Technical College, Hackney, E.8, which also offers a College Diploma Course in Leather Goods.

Part-time day and evening courses are also provided in the colleges and the latter were established as early as 1885 at Northampton and 1892 at Norwich. These courses now lead to the Full Technological Certificate of the City and Guilds of London Institute, and the graduateship of the British Boot and Shoe Institution, B.B.S.I. A very high degree of skill is required in the majority of operations on footwear manufacture as the shoe is manually presented to a power-driven tool. Recruitment to and training, especially in part-time day courses, for the industry is encouraged by the National Joint Recruitment and Training Council set up in 1947 by the Incorporated Federated Associations of Boot and Shoe Manufacturers, the National Unions of Boot and Shoe Operatives, the National Institution of the Boot and Shoe Industry. The B.B.S. Institution encourages students with the award of scholarships and grants from its Merit Fund, and provides a Footwear Design Bursary under the Royal Society of Arts Bursaries Scheme.

REFERENCES

C.Y.E.E. Pamphlet No. 3, *Boot and Shoe Manufacture.*
British Boot and Shoe Institution, Northampton.
A.A.C.P. Report, *Footwear.*
British Boot and Shoe and Allied Trades Research Association (p. 621).

Ceramics

The needs of the Potteries and elsewhere for education in ceramics are met by courses at the North Staffordshire Technical College, Stoke-on-Trent. A three-year sandwich course (six monthly turnabout basis) leads to the Pottery Manager's Certificate examinations and students who pass may subsequently qualify for the award of the Certificate after the specified period of practical experience—which is an interesting and specially valuable variant of the usual sandwich course arrangement. A three-year Diploma Course in Ceramics is provided for intending research workers and laboratory technicians controlling production.

The courses cover the general ground required for the pottery industry, the iron enamelling industry, the building industry, and the refractories industry. The scope is thus vastly wider than the general conception of the pottery industry as producing mainly household crockery, and modern developments have greatly increased its scope and the range of interesting occupations. The College has long had an interest in research and from it stemmed two research associations, later combined to form the British Ceramic Research Association. The College maintains a testing laboratory to serve industry which provides valuable training for young laboratory technicians before they pass into the industry. There is the usual range of part-time day and evening courses for those employed at all levels in the industry. Students may take the Pottery Manager's Certificate examinations after six years' attendance, study and industrial experience.

Recently a substantial development has taken place in the School of Ceramics of the Royal College of Art to provide the training of top-level craftsmen and designers for the pottery industry, and thus to provide an artistic and creative counterpart to the technical and managerial training outlined above. In addition to the foregoing major centres, pottery is made and related education provided in other centres such as Derby, Worcester, Poole, Newcastle-on-Tyne and Bristol. In Scotland, Barrhead, Paisley, Kilmarnock and Bo'ness are important centres. New schemes of training are being brought in, which allow more opportunity for the choice of a particular career in the first two years of training.

REFERENCES

C.Y.E.E. Pamphlet, New Series No. 6.
Prospectuses of North Staffordshire and other Technical Colleges concerned.
British Ceramic Research Association (p. 622).

Chemical Engineering

It is fashionable to point to British discoveries which were subsequently developed abroad, from Perkin's discovery of mauve to Sir Alexander Fleming's discovery of penicillin. The rapid establishing of the industrial process for penicillin in the U.S.A. during the war is alleged to be due to our lack of ability to exploit it and to the lack of chemical engineers in particular. Conversely the post-war building of petroleum refineries and 'cracking' plants by American engineers has pointed in the same direction. In point of fact our hazardous position in the war was a prime factor in not developing penicillin here, and the U.S.A. had had a half century's start in petroleum technology, due to natural resources which still account for something like 60% of the world's oil. Again, recently discovered fibres have been developed more quickly elsewhere; for example, the British discovery terylene was marketed two years earlier in the U.S.A. than in this country. Again it may be argued that this was due to very unfavourable post-war economic conditions here, yet when all has been allowed, the lack remains and the number of chemical engineers is far below that required to solve present problems.

Chemical engineering is the fourth primary technology, a fundamental position which is still not conceded in some quarters, as typified by those who still assert that a chemical engineer talks chemistry to an engineer, engineering to a chemist and when both are present he talks about the weather, or golf. Sir Harold Hartley, F.R.S., has emphasised the historical succession of the primary technologies. 'First there had been civil engineering, which had claimed the whole field, then, from the introduction of the steam engine, the specialised techniques of the mechanical engineers had developed; and the same process had happened again in the case of the electrical engineers. Now in the twentieth century, with the great developments of the chemical industry and the invasion of all processing industries by chemical techniques this fourth primary technology had developed.'

The Cremer Report on Chemical Engineering Research specially emphasised that whereas the special technologies are concerned with the *processes* of manufacture of *particular* products, chemical engineering is concerned with the study of *plant* and *operations*, which are *generally and widely* applicable to all industries. The chemical engineer finds a variety of opportunity in the chemical, plastics, rubber, petroleum, fats and oils, solvents, food processing, rayon and synthetic fibre industries, the coal, gas and tar industries, as well as with engineering firms specialising in the construction of chemical plant. The direct relevance of chemical engineering to many of the technologies dealt with in this chapter will be apparent. The continuing urgent need for chemical engineers has been emphasised repeatedly in all the authoritative statements and publications listed below, to meet which the following main forms of education exist, and both need much greater numbers of students and expansion of courses.

Full-time study can be taken in degree courses in chemical engineering at a few universities and at Manchester College of Technology, Birmingham College of Technology, Royal Technical College, Glasgow, and has recently been established at the Heriot-Watt Technical College, Edinburgh. A four-year-full-time Diploma Course is provided at Loughborough College of Technology. An advantageous route is to take a post-graduate course in chemical engineering following a university first degree, college associateship or professional associateship in chemistry or engineering. Such courses are offered at some universities and at the following technical institutions; Battersea Polytechnic, London, S.W.11; Bradford Technical College; Glamorgan Technical College, Treforest; Loughborough College of Technology; Manchester College of Technology; West Ham College of Technology.

The professional institution is the Institution of Chemical Engineers (founded 1922) and, as with other technologists, those employed in industry may study for its examinations (for A.M.I.Chem.E.) in part-time courses by various stages. This may be by taking an external degree (engineering or chemistry) or A.R.I.C. followed by chemical engineering courses, or by first taking O.N.C. in Chemistry, Applied Chemistry or in Mechanical Engineering, then H.N.C., and by subsequent study and approved experience to qualify for A.M.I.Chem.E. Higher National Certificate Courses in Chemical Engineering are offered at Acton, Battersea, Birkenhead, Bradford, Huddersfield, Kingston-upon-Hull, Manchester, Treforest and West Ham. The Glamorgan Technical College, Treforest, has pioneered in establishing a four-year Diploma sandwich course in Chemical Engineering, and another sandwich course is being established at the Royal Technical College, Salford.

REFERENCES

Institution of Chemical Engineers (p. 618), from whom various publications can be obtained, including a pamphlet, *Careers in Chemical Engineering.*

Sir Harold Hartley's Presidential Address to the Institution of Chemical Engineers, Trans. Inst. Chem. Eng., 1952, 30, 13.

A.A.C.P. Reports, *Universities and Industry*; *Heavy Chemicals*; *Chemical Engineering in Industry*; Symposium at British Association, September, 1952:—

The Training of Chemical Engineers, by Professor D. M. Newitt, F.R.S.

The Chemical Engineer in Industry, by Dr. E. H. T. Hollyn with discussion thereon, including contribution by Sir Harold Hartley, F.R.S., reported in *Advancement of Science*, 1953, X (No. 37), 3–11.

Present and Future Supply and Demand for Persons with Professional Qualifications in Chemical Engineering (H.M.S.O.).

Report of the Committee on Chemical Engineering Research (Chairman, H. W. Cremer, C.B.E.) (H.M.S.O., 1951).

Chemical Apparatus in the U.S.A.; Report of Technical Assistance Mission No. 23, published by the Organisation for European Economic Co-operation, Paris, 1952. This goes beyond its restricted title, e.g. Chapter I deals with profession of chemical engineer, and compares European and American conditions.

Department of Scientific and Industrial Research (Appendix, p. 616), has recently established a chemical engineering research department.

The Functions and Education of the Chemical Engineer, Papers presented at the Conference, 21st–23rd March, 1955, London, organised by the Institution of Chemical Engineers and the O.S.I.R., for the European Productivity Agency of the Organisation for European Economic Cooperation (O.E.E.C.).

Clothing Technology

Though the retail clothing trade is widely distributed and in every town, the manufacturing side is concentrated in certain main centres, shown by the fact that the Clothing Institute now has branches in Birmingham, Cardiff, Glasgow, Leeds, London, Manchester, Newcastle, Nottingham and South Wales. The main educational developments have been in these areas as, for example, the Shoreditch College for the Garment Trades (Curtain Road, E.C.2) and the Department of Clothing Technology at the Leeds College of Technology, and their work and courses may serve to illustrate the general pattern.

At the Shoreditch College there is a one-year full-time course for boys or girls aged 15 or 16 entering the clothing industry, and a second year for those wishing to obtain more responsible posts. The full-time course is available in dressmaking, or ladies' tailoring or men's tailoring; part-time courses are provided in these subjects and also in embroidery, millinery, fashion design and in related crafts, and students take the appropriate City and Guilds Examinations.

At Leeds a two-year full-time course for the College Diploma covers the fundamental principles of the production of men's and women's outer wear and students are concurrently prepared for the City and Guilds final examinations in cutting and tailoring men's and women's garments (wholesale). A further year of study can be taken in advanced specialised subjects leading to the Full Technological Certificate of the City and Guilds of London Institute. Another two-year full-time Diploma Course is in dress design and garment construction which also leads to appropriate City and Guilds Examinations.

A full range of part-time and evening courses is available at these and in many colleges for those engaged in the industry to take equipment studies over a longer period of time, but the total number of enrolments is very small, especially in full-time courses, for an industry employing about 500,000 people.

As with printing, the design aspect is no less important than the technology and this is provided for by colleges and schools of art in the various centres, as, for example, by the Department of Dress Design at the Leicester College of Art.

The Clothing Institute was founded in 1948 as an independent educational and professional institute to promote the interests of the clothing and allied industries, especially in relation to education and the acquisition and recognition of professional skill. The Institute is authorised by the Board of Trade to define courses of training, conduct examinations and award Diplomas of Associate (A.C.I.) and Fellow (F.C.I.). A Full Technological Certificate in Clothing Technology of the City and Guilds of London Institute gives exemption requirements for the Diploma Award of Associateship.

REFERENCES

The Clothing Institute (p. 617).
C.Y.E.E. Pamphlets New Series No. 9, *Dressmaking*; No. 10, *The Dress Designer*; No. 11, *Wholesale Clothing Manufacture, Part I, The Clothing Factory*; No. 12, *Wholesale Clothing Manufacture, Part II, The Cutter.*
A.A.C.P. Report, *Men's Clothing.*

Coal Mining

The coal industry has been a key source of Britain's strength and prosperity, and in an increasingly competitive world has of necessity become more and more scientific and technological in its methods, both of winning and processing the entry requirements are G.C.E. Ordinary Level in four subjects and Advanced Level in at least one science subject, such as chemistry, physics or biology. One-year courses of post-graduate study are offered in Applied Microbiology and in Food Quality Control.

The National College also provides regional courses of training for masters and all others engaged in the meat, fish, fruit, vegetable and milk trades. Full-time day, part-time day and evening courses are provided to meet a variety of needs, and students are prepared, *inter alia*, for the examinations held by the Institute of Meat, by the City and Guilds of London Institute in Milk and Milk Products, and by the Royal Sanitary Institute for Inspectors of Meat and Other Foods, and in Food Hygiene and Nutrition.

In addition to the National College many technical colleges offer part-time day and evening courses leading to the City and Guilds and Royal Sanitary Institute Examinations respectively.

REFERENCES

Prospectus of National College of Food Technology (p. 603).

A.A.C.P. Reports, *Meat Packaging and Processing*; *Packet Foods*; *Food Canning*; *Fruit and Vegetable Utilisation Milk*; *Utilisation*; *Fruit and Vegetable Storage and Prepacking.*

British Food Manufacturing Industries Research Association (p. 622).

Foundry Technology

The foundry industry was formerly largely confined to the areas of the iron and copper smelting industries, but with the coming of new metals, alloys and processes it has been much more dispersed and diversified. It occupies a key place in the production side of industry which led to the foundation in 1948 of the National Foundry College within the Wolverhampton and Staffordshire Technical College as the sequel to the pre-war British Foundry School at Birmingham Premises for the National Foundry College, as part of the Technical College extensions, were opened in February, 1954, and provide special laboratories for the chemical analysis, heat treatment and metallographic examination of ferrous and non-ferrous metals, and a specially designed and fully equipped foundry.

The National College provides a Diploma Course comprising six months' college experience, then six months' industrial experience, and then one full academic year at the college. The standard of entry is either a Higher National Certificate in Metallurgy, Engineering or Chemistry, or a City and Guilds Final Certificate in Foundry Work, Metallurgy or other appropriate subject. More highly qualified entrants—in qualifications and/or experience—may be admitted direct to the second part of the Diploma Course. Scholarships to these courses are awarded by the Governors, and Founder's Company Fellowships may be given for success in the Diploma Course. One important feature of attendance at the College for the Diploma Course is the opportunity for residence at the College Hostel situated in attractive surroundings. As with other national colleges local work is also undertaken, in this case for the City and Guilds courses in foundrywork and pattern making.

A two-year sandwich course in pattern making and foundry technology, with recruitment after S.2 is provided at the Constantine Technical College, Middlesbrough. Part-time day and evening courses for the City and Guilds Examinations are provided at many colleges in industrial areas.

REFERENCES

Prospectus of the National Foundry College, Wolverhampton.
C.Y.E.E. Pamphlets, Choice of Careers, New Series, No. 19, *The Foundry Industry*; No. 20, *Foundry Craftsmen, The Moulder*; No. 21, *Foundry Craftsmen, The Patternmaker*.
A.A.C.P. Reports, *Grey Ironfounding*; *Brassfoundry*; *Fine Aluminium Die Casting*.
British Cast Iron Research Association (p. 622).
British Non-Ferrous Metals Research Association (p. 622).

Fuel Technology

The winning of coal is one technology (p. 401), its efficient preparation and utilisation is another, and the same is true of oil (p. 415). Whereas in this country there is a great difference in the magnitude of natural resources of coal and oil, both are of great and growing importance at the refinement and utilisation stages. This is because of the ever-increasing world demand on limited fuel resources for heating, lighting and power. Because of the vagaries of natural distribution in the earth, they are a most powerful factor in world trade at all levels from raw materials to finished products, to which they contribute a growing and inescapable proportion of the final cost. The profession of fuel technologist is therefore assuming increasing importance, especially in securing the more efficient use of fuel in this country. With coal alone there is still regrettably ample room for improvement; the evil effect of smoke on human health, the destruction of buildings and the general squalor it produces are painfully evident to any intelligent person.

For study in fuel technology to professional standards, degree courses in engineering or chemistry followed by a postgraduate Diploma Course at a university or technical college are appropriate. In some the degree course is in fuel technology or chemical engineering or applied chemistry with special reference to fuel. Full-time study is also available for the Associateships of certain colleges; the Heriot-Watt College, Edinburgh; the Royal Technical College, Glasgow; the Manchester College of Technology, and there is a full-time Diploma Course in chemical engineering with special reference to fuel technology at the Glamorgan Technical College, Treforest.

For the part-time student already engaged in the industry there are the City and Guilds of London Institute Examinations in Fuel Technology and, through a scheme revised in 1953, completion of the Advanced Grouped course is accepted by the professional institution, the Institute of Fuel, as complying fully with the examination requirements for corporate membership. For purposes of admission to Corporate Membership itself, a candidate must of course comply with the Institute's Bye-laws in regard to practical training and experience and in other particulars.

REFERENCES

The Institute of Fuel (p. 619).

Dr. D. T. A. Townend, C.B.E., *The New Education Scheme of the Institute of Fuel*, Address to the Institute, 29th April, 1954.

N.L.N.S., Pamphlet No. 19.

A.A.C.P. Reports, *Fuel Conservation*; *Coal*; *Gas*.

A. Marsh, *The Problem of Coal and the Atmosphere* (Faber, 1947).

R. S. Scorer; 'Smog', *Science Progress*, 1954, XLII. (No. 167), 396.

Furniture and Timber Technology

The traditional making of furniture by individual craftsmen has undergone great changes especially since the first world war. The cutting and shaping of wood is almost entirely done by machine, mass production methods are widespread and powered hand tools are now coming into use. Modern materials, such as plywood and laminated wood, with different properties have accelerated this change which also is seen, for example, in the prefabrication of spring units and upholstery made of foam rubber. The outstanding centres of the industry in England are High Wycombe and London, and in Scotland, Glasgow and Beith.

Courses of study include full-time courses lasting three or four years for intending designers and those who wish to enter the production and planning side, and part-time courses for learners already in the industry. Full-time courses on furniture design and the technique of furniture manufacture are held at the Royal College of Art, the Central School of Arts and Crafts and the Shoreditch College for the Furnishing Trades in London; in the Colleges of Art at Beckenham, Canterbury, Birmingham, Leicester and High Wycombe College of Further Education. The Edinburgh College of Art has a four-year Diploma Course in design, in which the last two years may include furniture design as a main subject. Glasgow School of Art has a similar course with interior design, including furniture design, as a main subject.

Most centres of the industry have part-time day and evening technical and design courses leading to the City and Guilds of London Institute Final Examinations in Cabinet and Chair Making, and the Diploma in Timber Technology of the Timber Development Association. The Ministry of Education National Diploma in Design (p. 317) can be taken in furniture and interior design. The Furniture Development Council, in consultation with other related bodies, is considering the setting up of an independent professional institution for the furniture industry.

REFERENCES

C.Y.E.E. Choice of Careers Pamphlet, New Series, No. 38, *Furniture Manufacture*; No. 18, *Wood Sawyer and Woodcutting Machinist.*
A.A.C.P. Report, *Furniture Woodworking Machinery.*
Timber Development Association Ltd. (p. 620).

Gas Engineering

The gas industry converts about 30 million tons of coal a year into smokeless fuels—gas and coke—and into other products which form the basic materials for important branches of the chemical industry. Gas engineering thus has two main sides—gas production and gas distribution, the latter entailing its efficient use and therefore including the design and manufacture of all gas-burning apparatus. Gas engineers find employment in the service of the twelve Area Gas Boards responsible for making and supplying the gas, coke and by-products and also with manufacturers of gas-making and by-product recovery plant and of gas-burning equipment such as cooking stoves, gas fires, water-heaters, industrial and gas-fired furnaces.

At the professional level, entry to the gas industry may be after taking a degree in fuel technology and gas engineering at Leeds University, or a degree in physical science or engineering at a university or technical college, followed by a post-graduate course in gas engineering or chemical engineering, or taking a graduate pupilship in the industry itself. Long established courses in gas engineering are offered at the Westminster Technical Institute, and a recent innovation is the College Associateship Course in Gas Engineering (three-year sandwich course from O.N.C. or Advanced G.C.E.) recognised by the Institution of Gas Engineers at the Royal Technical College, Salford,

Employees in the industry take courses leading to Higher National Certificates in Civil and Gas Engineering, and also in Mechanical Engineering, which gain exemptions from appropriate parts of the examination for the Associateship of the Institution of Gas Engineers. Non-professional courses in gas technology (manufacture) and (supply) are held in many technical colleges, primarily for supervisors, and lead to Final Certificates of the City and Guilds of London Institute. Apprentices take systematic craft courses leading to examinations conducted by a Joint Advisory Committee of the City and Guilds of London Institute and the Regional Examining Unions. The difficult problem of providing adequate practical facilities is being tackled by the Area Gas Boards in making them available in a few centres in each region, while the local technical colleges provide the theoretical instruction by full-time staff and by engaging specialist staff from the industry.

REFERENCES

The Profession of Gas Engineering, pamphlet published by the Institution of Gas Engineers (p. 618).

A Career in the Gas Industry, pamphlet published by the Gas Council, obtainable from local Gas Offices.

M.L.N.S., *Careers for Men and Women*, Pamphlet No. 19.

A.A.C.P. Report, *Gas*.

Heating and Ventilating and Refrigeration Engineering

Until the National College was established in 1948 there was little provision for advanced study or research in these branches of technology. Following the publication of the Percy Committee Report (p. 453), the heating and ventilating and the refrigeration industries severally applied to the Ministry for the establishment of colleges to meet their individual needs. The Ministry expressed the view that one college embracing their own and allied industries would be preferable, and after some negotiation the National College was established at the Borough Polytechnic, London, S.E.1.

The Diploma Courses, with O.N.C. Mechanical Engineering entry standard and lasting two to three terms, are in heating and ventilation engineering, in refrigerating engineering and in fan engineering respectively. The Diploma carries appropriate exemptions from the examinations for the Associate Membership of certain professional institutions. A Fellowship is awarded for contributions of outstanding merit in research to the benefit of the college and industry. There is a hostel for full-time students, who are eligible for Bursaries awarded by the Association of Heating, Ventilating and Domestic Engineering Employers. Ten scholarships are offered for Diploma or Degree students for the higher course for the College Associateship or for research.

At regional level evening classes are arranged to meet the requirements of the Associateship of the professional institutions, and for the immediate local area the college provides part-time day courses for operatives leading to the Final City and Guilds Examinations.

The Institution of Heating and Ventilating Engineers (founded 1897) assesses the examinations for its Diploma for exemption from the heating and ventilating and the fan engineering subjects of the final professional examinations. The Institution has, during the past few years, appointed a Research Fellow at the National College, the value of the Fellowship being £500 per annum.

Part-time courses are held in a few colleges as, for example, at the Birmingham College of Technology.

REFERENCES

Technical Education in the Heating and Ventilating Industry, published by the Education Board of the Heating and Ventilating Industry.

The Institution of Heating and Ventilating Engineers (p. 618).

Prospectus of the National College for Heating, Ventilating, Refrigeration and Fan Engineering at the Borough Polytechnic (p. 603).

Horology

The history of the development of the science and art of horology has been enriched by the inventions and skill of many famous British watch and clockmakers, but it has taken two major wars to demonstrate the necessity of having a high-grade active and efficient industry for the manufacture of all types of clockwork mechanisms and other precision mechanical devices.

In consequence the Ministry of Education, together with the various interests involved, set up in 1947 the National College of Horology to provide appropriate educational training and research facilities at the Northampton Polytechnic, Clerkenwell, E.C.1, because of its location and of its past experience in providing instruction in watch and clock-making.

The three-year full-time course leads to the Diploma in Horology; general subjects such as mathematics attain the standard of Part I Final Degree in Engineering and the specialist subjects reach somewhat higher. The aim is not to produce craftsmen, but about fourteen hours of practical work per week are included in each year of the course, in order to familiarise the student with workshop methods, machines and production techniques.

The students attend the college for some 35 hours per week for 36 weeks per session. At the end of the first year a further six weeks are spent entirely in the college workshops, and at the end of the second year a similar period is spent on a vacation course in the works of a suitable industrial organisation. At the end of the Diploma Course, student apprentices spend two years on practical training in the workshops and laboratories of member firms of the British Clock and Watch Manufacturers' Association. The Diploma is recognised for exemption from relevant parts of professional institutions' examinations and by the British Horological Institute.

Recruitment to the course is both direct from school and from the industry but, even if present trends are reversed, it still seems likely to be largely from the schools. Plans are in hand for the development of courses in instrument technology, and two-year full-time courses in tool technology have been started for students with National Certificates in Mechanical or Production Engineering; it will be interesting to see how far industry supports these and other ventures designed to recruit good students from within industry.

REFERENCES

Prospectus of the National College of Horology and Instrument Technology (p. 603).

'The Training of Horological Engineers', K. J. Hume, *Research*, 1952, Vol. 5.

Horticulture

Horticulture is taught in some technical colleges, but most of the educational facilities are provided in universities and agricultural colleges. Technical college courses are part-time for those already engaged in such occupations, and lead eventually to the National Diploma in Horticulture (N.D.H.) awarded on examinations conducted by the Royal Horticultural Society under a scheme approved by the Ministry of Agriculture and Fisheries.

Opportunities in horticulture are mainly in practical market gardening and fruit growing, which generally require capital to start, though there are some managerial posts. Other posts are head gardeners in charge of public or private gardens, foremen and charge-hands in large commercial undertakings, and relatively few research and teaching posts.

REFERENCES

M.L.N.S., *Careers Booklet*, No. 3.
Ministry of Agriculture Advisory Leaflet No. 236, *Commercial Horticulture, Advice to Beginners.*

Leather Technology

In 1895 the Worshipful Company of Leathersellers, one of the Ancient Guilds of the City of London, sponsored classes in heavy leather manufacture which led through various developments to the establishment in 1909 of the Leathersellers' Technical College, Bermondsey. In September, 1951, this college became the nucleus of the National Leathersellers' College.

The British Leather Manufacturers' Research Association, founded in 1921, has greatly stimulated the immense development in the science of leather manufacture since then. This has made it imperative for the industry to have trained technologists capable not only of understanding the scientific principles underlying the manufacture of leather, but able to put the latest developments into practice. To secure this a full-time two-year Diploma Course is provided, which leads, after a further specialised year, to the Associateship of the College (A.L.C.). Students with university science degrees or equivalent qualifications may also take the third year. Plans are in hand for the development of research, and for holding intensive short courses for senior employees in the industry, for example in modern practice in chrome tanning and methods of control; water pigment and nitro-cellulose finishes; leather dyeing; hot pitting and bleaching of sole leather. Various scholarships have been founded by the industry for students to attend the college.

Evening courses are held for students already employed in the industry and lead to the City and Guilds Final Examinations in Leather Manufacture (Tanning and Dressing of Heavy and Light Leather) and Leather Dyeing and Finishing. Part-time day and evening courses are also arranged for these examinations by a few colleges, notably at Northampton College of Technology where there is a fully organised Department of Leather Manufacture, with a two-year full-time course for students from 16 years of age, which leads to the City and Guilds examinations.

REFERENCES

Prospectus of the National Leathersellers College, London, S.E.1.
British Leather Manufacturers' Research Association (p. 622).

Marine Engineering

Marine engineering, which has mechanical engineering as its essential basis, embraces all the engineering work in a ship, including the propelling machinery, electrical generation and distribution, refrigeration, ventilation and so on, except the hull which is the concern of the naval architect. Engineers who work in firms making all this equipment will train as mechanical engineers (p. 248), but for the sea-going engineer the usual qualification is the Ministry of Transport Certificate of Competency, for which a four-year apprenticeship in heavy engineering and considerable sea-going experience is required.

Since the war an acute shortage of sea-going engineers has resulted in a new Ministry of Transport Scheme (in 1952), designed to supplement the traditional method of qualifying by going to sea and studying in periods of leave ashore. Candidates who are 16–18 years of age, proficient in mathematics and physics or have taken a part-time engineering course at a technical college, are interviewed by the firm and by the technical college. After medical examination and acceptance, the young man is registered as an Apprentice Engineer with the Ministry of Transport (Marine Division) and then undergoes the following training; two years at an approved technical college for a recognised National Diploma in mechanical engineering; one and a half years afloat as apprentice engineer in ships owned or operated by the Company; one year's training in fitting, erecting or repairing of machinery at an engineering establishment approved by the Ministry of Transport.

The firm pays college fees, supplies travel warrants as required and the students receive wages when at college as well as at sea. Already there is good co-operation between the firms and the colleges, and the scheme offers splendid opportunities of a kind undreamt of by former generations of sea-going engineers.

From its nature this scheme can be and has been established in industrial areas not usually associated with the sea, e.g. Acton, Bolton, Huddersfield, thus increasing potential recruitment. Long-established courses for sea-going engineers on shore leave are held in technical colleges at the seaports as at Aberdeen, Belfast, Cardiff, Dundee, Glasgow (Stow College), Greenock, Kingston-upon-Hull, Leith, Liverpool, Poplar, South Shields, Sunderland.

When the marine engineer comes ashore at the end of his sea-going career he can usually obtain employment as a maintenance engineer, or surveyor.

REFERENCES

Institution of Marine Engineers (p. 618).
M.L.N.S. Careers Guide.

Naval Architecture

The naval architect is concerned with the design of a ship, which is a highly specialised form of engineering in which many conflicting factors must be resolved. These include the demand for speed, for maximum space for cargoes and for space, comfort and attractiveness for passenger vessels, special designs as for oil tankers and salvage vessels, economic working, and the inescapable requirements of stability and seaworthiness. With all this must go a working knowledge of propulsive machinery, steering gear, lifting tackle, refrigeration and all the other auxiliary machinery required in a ship. The designer of naval vessels has still more exacting requirements in armaments and the stresses they induce in the ship's structure.

High capability in mathematics is absolutely essential for success in this profession, and many other abilities and qualities (including an aesthetic sense of form) are very desirable. The education required is a blend of theory and practical experience. A long-established three-year Diploma (sandwich) Course is held at Sunderland Technical College, and a four-year Associateship Course at the Royal Technical College, Glasgow. Courses for the Higher National Certificate in Naval Architecture are held at Barrow-in-Furness, Birkenhead, Cowes, Gillingham, Plymouth and Devonport, Portsmouth, Newcastle, Southampton, Sunderland, Dundee, Kirkcaldy, Paisley, Aberdeen, Glasgow (Royal Technical College) and Belfast.

REFERENCES

The Institution of Naval Architects (p. 617), which issues a pamphlet, *The Profession of Naval Architect.*

Ministry of Labour and National Service Careers for Men and Women Pamphlet, No. 20, *Naval Architecture.*

Navigation and Nautical Courses

An admirable survey of recruitment and training for the Merchant Navy has recently been made by Dr. J. Hargreaves, and here is but a brief summary of the training which falls into three categories (1) deck engineering and radio officers; (2) petty officers, i.e. stewards, pursers, etc.; (3) deck and engineroom ratings. Because of the special measures to deal with the long continuing acute shortage, the marine engineers have been dealt with separately (p. 412). The training of non-officer categories is mainly given by the industry itself, and is effected by courses of very short duration.

At the present time radio officers are trained in the Technical Colleges at Kingston-upon-Hull, Norwood, South Shields, at Greenock (Watt Memorial School) and at Leith Nautical College. The courses lead to Certificates of Proficiency for radio officers, issued by the Postmaster General after examinations in three grades, 1st Class, 2nd Class and Special Certificates, the last being valid only for service in ships not compulsorily fitted with radiotelegraphic equipment. Unlike the deck and engineering appointments, a radio officer may complete the whole of his training before going to sea. The increasing participation of the maintained technical colleges in this work should help greatly to raise the standards of this training and the status of the occupation of radio officer.

For the career of deck officers, the pre-sea training is rightly receiving increased emphasis under the guidance of the Merchant Navy Training Board, which is bound to have beneficial effects on later training. Statutory requirements are laid down for the number and status of officers required for foreign-going and home-trade ships, and for examinations and period of service at sea for the Certificates for Master, First Mate and Second Mate respectively, to which has been added the Extra-Master's Certificate of graduate equivalent standard, which is taken voluntarily. Candidates must pass a rigid eyesight test, including form and colour vision, on the occasion of each examination. The increased use of modern electronic and other navigational aids has necessitated a recent revision of the syllabuses, and the introduction of a new certificate for radar observers.

Courses for deck officers are provided at the following technical colleges; Aberdeen, Bristol, Cardiff, Dundee, Glasgow (Royal Technical College), Grimsby, Kingston-upon-Hull, Liverpool, Plymouth and South Shields; in London at the King Edward VII Nautical College and at the Sir John

Cass College; Fleetwood Navigation School; Greenock Watt Memorial School, Leith Nautical College.

All the colleges have to be very flexible in their general attitude and arrangements, in that the senior courses in navigation and marine engineering must be ready to take a student, not at set enrolment dates, but within a very short time of his leaving his ship. The colleges also arrange correspondence courses to enable students to continue their studies at sea, and mention must also be made of similar and other facilities offered by the Seafarers' Education Service and its College of the Sea.

REFERENCES

Training for the Merchant Navy, Dr. J. Hargreaves, Principal, South Shields Marine and Technical College, A.T.I. Paper, February, 1954.

M.L.N.S., *Careers Guide*, 1950, p. 78.

Report of the Seafarers' Education Service.

Oil Technology

This overlaps with fuel technology (p. 405) and chemical engineering (p. 398) but in recent years there has been a rapid development of the oil industry in this country. Apart from the long-established shale oil industry in Scotland, there are the attempts to discover other natural petroleum and oil deposits, with the small results so far at Eakring, Nottinghamshire. These explorations are being pressed forward under new and ambitious schemes, and discoveries of large deposits would clearly have a far-reaching effect on the national economy and on opportunities for employment. So far, however, the major post-war development has been in the building of immense 'cracking' and refining plants dealing with imported petroleum, as at Fawley, Stanlow, Coryton and Partington. By this process of cracking, the large molecules of petroleum are broken down under drastic but carefully controlled temperature conditions and with the use of a catalyst, into smaller molecules which are of much greater value for a wide variety of purpose. These purposes include use as aviation spirit, commercial petrol, kerosene, fuel oils, diesel oils, lubricating oils, petroleum jelly, and raw materials which serve as a starting point for the production of a very wide variety of chemicals. The process of 'cracking' is followed by refining processes to separate all these materials from which others can be built up or synthesised. Altogether over 2,000 products can be manufactured from petroleum.

Education for this industry is by a degree course with a bias towards oil engineering, or by a degree or higher diploma course in chemical engineering, chemistry, or mechanical engineering, all with post-graduate Diploma Courses in Petroleum or Fuel Technology. The part-time students may study for an external degree or for A.R.I.C., or for the National Certificate in Chemistry, in Chemical Engineering or Mechanical Engineering with appropriate further study in Fuel or Oil Technology; the latter may be supplied by courses held by the firm, or he may take the City and Guilds Courses in Petroleum and Petroleum Products.

REFERENCES

The Institute of Petroleum (p. 619).
The Institution of Chemical Engineers (p. 618).
The Institute of Fuel (p. 619).
S. Schachue and N. D. Drake, *Oil for the World* (Esso, 1950).
British Industries: Oil (Shell Petroleum Co., and Cassell and Co. Ltd., 1953).

Paper Technology

H. G. Wells envisaged that a fungus or micro-organism capable of destroying paper could destroy the basis of modern civilisation. This imaginative testimony to its ubiquity and immense importance is in striking contrast with the few localities in which it is manufactured in this country, viz.: Watford, Gravesend.

No full-time courses exist on paper technology, and senior posts in the industry may be gained either by those who first take degrees or equivalent qualifications in engineering or chemistry, and acquire their paper technology by practical experience, or by those working in industry who acquire similar qualifications by part-time study, and/or take part-time courses in paper technology which lead to the City and Guilds of London Institute Final and Full Technological Certificate in Paper Technology. Such courses are provided at Aberdeen, Edinburgh (Heriot-Watt College), Glasgow (School of Engineering), London (School of Printing and Graphic Arts, and Borough Polytechnic), and Maidstone.

REFERENCE

British Paper and Board Industry Research Association (p. 622).

Pigments, Paints and Varnishes

While the use of these materials is extremely widespread, the centres of production are limited in number and few colleges provide courses, e.g. East Ham and The Borough Polytechnic, S.E.1. As with the paper and other industries, training may be by taking a degree or A.R.I.C. course, either full-time with the technological experience gained subsequently, or concurrently for the part-time student, or it may be through the courses leading to City and Guilds qualifications, of which there are three.

The Operatives' Course is of three years' duration, from about 15 to 18 years of age, and on a basis of elementary science and calculations it provides a specialised third year of paint application and colour matching, and factory layout and plant. The Paint Technologists Course is a much more exacting one of five years' duration, and requires much more chemistry (inorganic, organic and physical) with an extended treatment of other subjects such as solvents, oils, resins and varnishes, paint manufacture and, at the Final stage, convertible coatings, lacquers, pigment—dyestuffs and lakes, methods of analysis and works practice. The third course is for Technical Service Representatives which is the same as the preceding one to the Intermediate stage, then specialising in the first year for the Final examinations with the same first three subjects, but the final year comprises the subjects office routine and salesmanship, and paint application (Advanced).

The foregoing arrangements are a very good example of diversification to meet the needs of different groups of students, yet having a sufficiently common number of subjects to minimise staffing and other problems in the technical college.

REFERENCE

Research Association of British Paint, Colour and Varnish Manufacturers (p. 622).

Plastics

The plastics industry is wholly a modern development on its synthetic side (rubber is also a plastic, p. 420) and began with Baekeland's work on the phenolic resins just over 50 years ago. As with rubber, the fundamental science is the physical chemistry of high polymers, and plastics result from the building up of large or macro-molecules from simple chemicals to pre-conceived specifications, to the so-called 'tailored molecules'. It is not surprising therefore to find the National College of Rubber Technology offering Diploma and Associateship courses, both full-time and part-time, which also lead to the City and Guilds Final and Full Technological Certificates in the Technology of Plastics, and to the Diploma and Associateship of the Plastics Institute (A.P.I.). Similarly full-time and part-time courses are available at the Borough Polytechnic, S.E.1, where about eight scholarships have been made available by the Trustees of the Plastics Industry Education Fund for the courses leading to the Diploma of the Plastics Institute. Part-time courses for the Diploma are held at the College of Technology, Birmingham; Stroud Technical College, and Newton Heath Technical College, Manchester; and for the Associateship at Birmingham and Acton Technical Colleges.

The Plastics Institute, founded in 1931, and organised in ten regional sections, has received support from industry in setting up the Plastics Industry Education Fund which provides training grants and other facilities. As with other technologies, employees in the industry study and qualify first for science and engineering degrees, and/or the Associateship of the Royal Institute of Chemistry. They may enter industry thereafter to gain their technological experience (on which the Plastics Institute is insistent), and can qualify for the Associateship by the submission of a thesis under prescribed conditions.

REFERENCES

The Plastics Institute (p. 620).

Anglo-American Council on Productivity Report, *Plastics Moulding. Education and the Plastics Industry*, J. Maitland-Edwards, A.T.I. Paper, 1948.

Printing

If paper be ubiquitous and of immense importance, printing is not far behind. From its nature printing is, however, practised far more widely than paper manufacture, and appears as a subject in the prospectuses of many schools and colleges of art and technical colleges. As an industry it has many aspects ranging from the aesthetic to the scientific and technological, and these are reflected in the courses available.

The London School of Printing and Graphic Arts provides some seventy subjects covering the particular aspects of printing, in full-time, part-time day and evening courses. It provides a three-year Diploma Course for prospective executives in the industry comprising the following: design, hand composition, monotype, line composition, foundry, letterpress printing, graphic reproduction, lithographic drawing, lithographic printing, principles of photography, photolithography, photoengraving, photogravure, silk screen printing, bookbinding, machine ruling, warehouse practice, science, theory of machine construction, bookkeeping and accounts, costing, estimating and aspects of management and management studies (for the B.I.M. Common Intermediate). This list is given partly because it shows the range of study required for a modern technology, but also for its implications regarding the even more exacting nature of part-time courses attempting to provide those already engaged in the industry with similar opportunities. Many of course are content with but a few or even a single branch of study as required by their occupations, many of which are highly specialised crafts and a lifetime's work in themselves. Other full-time three-year courses at the London School of Printing are in commercial design and typographic design respectively, and part-time day and evening courses are also held in these.

Other important centres of printing which have colleges with established departments of printing, providing both full-time and part-time courses, are the following: Edinburgh (Heriot-Watt College), Leeds (College of Technology), Leicester (College of Art) and Watford (Technical College). At Leeds the Printing Department has been affiliated with the University whereby a student can combine a degree course with a technological course in printing. This is an additional provision to the three-year full-time Diploma Course.

The aesthetic aspect has been mentioned, and this is treated in the colleges of art, especially the Royal College of Art which in its School of Graphic Design provides a three-year Diploma Course in Graphic Design (commercial design and/or typography, and in the kindred arts of lettering, illustration and bookbinding).

The printing industry is exceptionally well organised in regard to apprenticeships and part-time day-release, and also offers scholarships for attendance at advanced courses.

REFERENCES

C.Y.E.C. Pamphlets, Choice of Careers, New Series, No. 45, *Printing*; No. 46, *Printing, Composing Room Crafts*; No. 47, *Printing, Machine Room Workers*; No. 48, *Printing, Photo-Mechanical Processes*; No. 49, *Bookbinding and Printer's Warehouse Work*.

A.A.C.P. Reports, *Letterpress Printing*; *Lithographic Printing*.

Prospectuses of London School of Printing and Graphic Arts (Appendix, p. 593).

Printing, Packaging and Allied Trades Association (p. 622).

Rubber Technology

The ramifications of rubber in the modern world are immense and ever-expanding; a moment's reflection on its uses only in motor and air transport and in the supply and use of electricity will underline its peculiar significance for our present-day civilisation. To the manifold effects and uses produced by the chemical treatment and the processing of natural rubber, are now added the fascinating problems and opportunities of synthetic rubber (verging away into synthetic plastics, p. 416).

The particular technological problems and distribution of the rubber industry led it to request the establishment of the National College of Rubber Technology, which was founded by the Ministry of Education in 1948. The National College began its work with the excellent equipment of the rubber department of the Northern Polytechnic. This has been transferred to a new air-conditioned building where much new machinery and scientific apparatus has been installed, and there is a large rubber machine shop, a vulcanising room, laboratories for specialised training in rubber chemistry, physics, physical testing and latex technology. Six research laboratories are available and facilities have been provided for any necessary engineering work. Students of the National College take ancillary subjects in the Northern Polytechnic and benefit from a wider social contact through membership of the latter's Students' Union.

The college provides a three-year full-time course for its Associateship (A.N.C.R.T.) and this qualification may also be gained after a one-year course by students who possess a British University degree in Chemistry or Physics, A.R.I.C. or A.Inst.P. Both courses also lead to the examinations for the Associateship of the Institution of the Rubber Industry (A.I.R.I.). A one-year full-time course leads to the Licentiateship of the College (L.N.C.R.T.) and of the Institution of the Rubber Industry (L.I.R.I.). Full-time and part-time research may be undertaken leading to M.Sc., or Ph.D., degrees of London University, and simultaneously to the Fellowship of the College (F.N.C.R.T.). Part-time day and evening courses are available for the Licentiateship and Associateship but are necessarily taken over a longer period.

Scholarships for the full-time courses are awarded by the College Governors, the Institution of the Rubber Industry and by the Dunlop Rubber Co. Ltd. An Educational Fund is being established by the Rubber and Allied Industries to provide further scholarships and exhibitions tenable at the college.

Part-time day and evening courses, leading to L.I.R.I. and A.I.R.I. are held in a few technical colleges recognised by the Institution of the Rubber Industry for the purpose, e.g. Newton Heath Technical College, Manchester.

REFERENCES

Prospectus of the National College of Rubber Technology (p. 603).
Institution of the Rubber Industry (p. 620).
Research Association of British Rubber Manufacturers (p. 622).

Textiles

The textile industry has many branches, with considerable localisation and specialisation in its organisation. Thus cotton is spun and woven chiefly in Lancashire and the Glasgow area, wool in Yorkshire and the Scottish Lowlands, linen in Northern Ireland, jute at Dundee, while the newer rayon and other synthetic fibres in which all branches are interested are produced chiefly in the Midlands, Essex and in North and South Wales. The industry offers immense scope, especially for applied scientists and technologists in the discovery and application of new fibres, dyes, finishes, in the design of new machines, and also in better techniques of management and in improving traditional methods of production. As with printing, the aesthetic side is important and the significance of textile design cannot be overestimated.

Provision is made for instruction in one or more textile subjects at 38 centres, of which 19 have a bias in favour of cotton, 12 of wool, 2 of silk and rayon, 1 of linen and 1 of jute, and 2 are mainly concerned with knitting and lace manufacture. In all the major colleges the technology of rayon and synthetic materials is included in the courses. Full-time Diploma Courses are provided at 14 technical colleges, and an innovation is the three-year College Associateship Course on the sandwich basis being established at Salford.

To achieve the status of a professional textile technologist by gaining the Associateship of the Textile Institute (A.T.I.), the student must be registered as a member of the Institute on prescribed conditions and then study, either in full-time or part-time courses for the Institute's Part I Examination in the subjects; fibres and their production; conversion of fibres to finished yarns; conversion of yarns into fabrics, fabrics produced by special methods; conversion of fabrics into finished materials. Holders of certain degrees and diplomas may gain exemption from the whole or part of this examination. The Part II examination is in the student's selected branch of textile technology at an advanced level and is on prescribed conditions, one of which is not less than two years' practical experience after the Part I examinations. The Senior award of the Institute is its fellowship, F.T.I.

National Certificate courses are provided in the colleges and these lead towards the A.T.I. examinations. Craft students prepare for the Intermediate Certificate of the Regional Examining Unions after three years' part-time study and two years thereafter for the City and Guilds Full Technological Certificate.

A number of colleges and schools of art (some in technical colleges, Appendix, p. 598) prepare students in the artistic aspects of textile design, with only sufficient technical knowledge to serve these ends. The Royal College of Art provides a full-time course in its School of Textile Design. The courses generally lead to the Ministry of Education National Diploma in Design, and the special position of the textile designer is recognised in the regulations for A.T.I. The Cotton Board exercises considerable educational influence through its Textile Design Centre, and the holding of many important conferences attended by directors, managers, trade union officials and technical college staff.

The British Rayon and Synthetic Fibres Association also maintains a Design Centre, and the Council of Industrial Design maintains a Record of Designers. The educational work of a Textile Training Guild has been noted on page 185, and also that of the Research Associations (Appendix, p. 621).

REFERENCES

Education for Careers in Textiles, published by the Textile Institute.
The Textile Institute (p. 620)
The Cotton Board, Manchester 2.
The Wool Secretariat (p. 620).
For the Cotton, Rayon, Linen Research Associations, see Appendix (pp. 622–3).

CHAPTER XIV

THE SCIENCES AND OTHER SUBJECTS

Modern science is only 300 years old, which is but a minute fraction of the history of man's civilisations, and its intense development and application spans scarcely more than 50 years. The present era has been called the physico-chemitechnic age (p. 38), and without the constant and increasing development and application of science it could not exist in its present form. This and the general line of development are exemplified in the courses provided by almost all technical institutions. The evolution of science has been from the physical sciences (physics, chemistry and related mathematics) to the biological sciences (botany, zoology, biochemistry) with more recently a quickened impetus to the social sciences such as psychology and sociology, though they still lag lamentably far behind in provision and support to meet the ever-increasing problems of a fast diminishing world. Thus in the technical colleges the physical sciences are quite well established though there is much room for development, while the biological sciences have but a footing and there is little sign of their development to meet the needs of industrial processes, based on fermentation and other biochemical methods, which are becoming an important source of many raw materials. The social sciences contribute a mere trickle to the flood of technical education, almost wholly through part-time courses which are mainly heavily disguised as management and administration, studies with very few full-time permanent appointments and even fewer courageous attempts at research into the manifold psychological and social problems in this field.

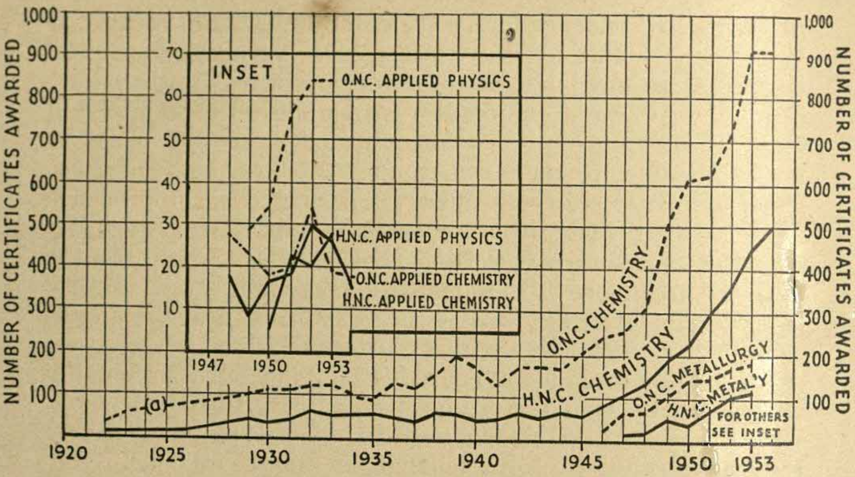
The sciences have been developed and still proceed by the investigation of natural phenomena under conditions which are as controlled or as accurately known as possible. The essence of the control is in the limitation and determination of variation in experimental conditions, and the rigorous checking of deductions, hypotheses and theories by further experiments under similarly controlled conditions [1]. The application of the scientific method does not result in the elimination of all sources of error, but in their reduction and control; if absolute truth were essential at each stage of an investigation, progress would be impossible. The second requirement, equally rigorous and equally difficult for the student to acquire, is the searching critical examination of all hypotheses and theories to ensure that they accord with present facts, and their re-examination in the light of newly-discovered facts. In this the guiding principle is 'Occam's Razor', a maxim attributed to William of Occam (*c.* 1290–1350), which is usually formulated 'Entities are not to be multiplied without necessity', but in its original terms was 'It is vain to do with more what can be done with fewer'. Thus if the facts resulting from an experiment or investigation can be explained or interpreted without assuming this or that hypothetical entity there is no ground for assuming it [2]. This can be styled as 'The Law of Economy of Hypothesis' or, put in more homely fashion as 'Don't use two explanations where one will do', a simple enough rule all too frequently forgotten in everyday life.

To these two requirements must be added a third, which in its full degree of quality and rarity distinguishes the original research worker. This is the intellectual power and imaginative insight to perceive and make the next step from the known facts through the formulation of verifiable hypothesis to lasting discoveries. These qualities are shown most dramatically in major discoveries, but they must be present in some degree on all occasions where an advance, however small, is made; without them the first two requirements cannot be fulfilled and to encourage their emergence is indeed a key problem of education. This certainly is not done through the enthusiastic encouragement of hunches, for 'Hunches, however correct they may turn out to be, can add nothing to understanding' [3]. Neither is it achieved through the patient accumulation of data and the rote memory of endless detail, covering the whole field of the syllabus and nowhere digging deep in understanding. The exacting consequences in teaching ability and example are dealt with in Chapter XVIII, and here we consider the varying significance of these three requirements at different levels of education provided in technical institutions.

At the craftsman's level the requirements are very simple in the maximum relevance of scientific information to his particular needs. This is shown in the use of the term 'building science' rather than chemistry and physics for builders or simply 'science for builders', so also mathematics or arithmetic becomes 'trade calculations' which is not simply 'gilding the philosophic pill' (which is not to be despised) but reflects a definite orientation of interest and motive. It is primarily a question of scientific information for immediate vocational use and not for scientific investigations. Nevertheless can the teacher somehow instil the beginnings of a scientific attitude of mind into the craft student, while dealing with and applying this scientific information on an admittedly very narrow basis? Can it be done in bakery science for the bakery student whose materials are mostly complex organic substances, or in science for the welder where the processes are combustion of gases, and also the fusion of metals with problems which would tax the expert metallurgist. By high scientific academic standards very little can be done, but it is not negligible, and indeed many of the crafts cannot now be fully mastered without this information and attitude of mind to new problems. At least the student will learn to recognise more rapidly what is new and what he cannot do, and he may do his work more effectively and even be able to solve some of his minor problems.

At the technician level the need for science is much greater for maintaining techniques and skills in which applied science is inherent throughout. Indeed many of the occupations were unknown or only remotely resembled their present form before the development of modern science. Examples of these are laboratory assistants and technicians in the chemical industries, the technicians who carry out tests on strengths of materials and design specifications, on raw materials and finished products, and also those in charge of the maintenance of production based on scientific processes rather than on empirical procedures, as in the production and spinning of new fibres. The technician may be required to recognise and deal with a wide range of problems and even to solve those which do not require long-term experimental investigations. For this he requires a definitely scientific attitude of mind, though he may not be competent either by ability or training to deal with all the technical problems arising in the normal course of his work, usually under a fully qualified experienced scientist or technologist. At least he will possess enough scientific information and skill to keep the work running reasonably smoothly; at best he will achieve a high degree of efficiency, and even be capable of improving the processes under his charge. In that event he will almost certainly begin to feel the need for a wider scientific education, especially when his capabilities and work verge on that of the technologist.

For the technologist the scientific requirements are inescapable and exacting, with the greatest emphasis on intellectual capacity and insight. If he is to become capable of innovation and development work, of establishing new processes



NOTE (*a*) Figures for 1924–28 not available

DIAGRAM 28. INCREASE OF AWARDS OF ORDINARY AND HIGHER NATIONAL CERTIFICATES IN CHEMISTRY, APPLIED CHEMISTRY, METALLURGY, PHYSICS

Sources: Tables in Ministry of Education Reports; Secretary of Royal Institute of Chemistry; and Secretary Institute of Physics

through the application of sciences, he must have his understanding and insight fostered by teachers capable and active in such work themselves, and also by working in industrial situations under the charge of men engaged in research or development. This is necessary both to the science and art aspects of his work (p. 447). As regards the science this means that he must be taught by teachers wholly engaged in scientific work and some at least must be actively engaged in research. Herein is the fundamental argument for well-established departments, for example, of chemistry, physics and mathematics of a quality in staffing and provision not inferior to that of the main technological departments (p. 577).

The interrelatedness of the sciences is complex and far-reaching as shown by Dr. H. J. T. Ellingham's interesting diagram [4], and they penetrate other departments far more widely than any other subject and discipline. This is true of chemistry and physics and is perhaps even more true of mathematics. They are thus apt to be known as 'service' departments, especially in those colleges where certain technologies such as engineering are very strongly represented. Only rarely is mathematics studied in technical colleges for its own sake, as for example for the Special B.Sc. Degree in Mathematics, and for the most part it is mathematics for engineers, builders and so on. In consequence mathematics is taught by the technologists rather than by professional mathematicians; too few Departments of Mathematics are established in their own right. The same is true to a lesser degree of physics (and now rarely of chemistry) which may still need and justify separation from a Department of Electrical Engineering or from a Science Department. One frequent arrangement is to combine both physics and mathematics and, generally, this is the best solution in borderline cases.

The emphasis should of course be on its justification in both administrative and educational terms. In colleges in areas with no great amount of scientific industry (as in a seaside resort) there may be an insufficient volume of chemistry, physics and mathematics courses to justify respective departments; a science department or one of science and technology may be the best solution. But with the usual lag in human developments, especially where vested interests are inevitable, the separation will probably take place later rather than too early. On educational grounds the separation should take place as early as possible, for the definite allocation of an academic responsibility to those most capable of undertaking it can be very stimulating, as experience has shown repeatedly in the growth of individual colleges. In general we therefore may expect to find such combined departments in smaller colleges or in those not in heavy industrial areas. For the rest the specialised science departments grow in status with the catchment area of the college, and especially in relation to the character of the industries. In a regional college they should compare with the major departments, not necessarily in the numbers of students (which is most unlikely in, say, physics compared with engineering) but in the level of courses, staffing and equipment. The grading of departments and staffing largely or preferentially on the basis of numbers of registered students is a cause of injustice to smaller, high quality and vital 'service' departments. Their importance is not only in their own right but also in that they provide the *lingua franca* or *via media* between the various technologies. This is a central position rather than the ancillary one implied in the term 'service department'.

A section of work which begins as a group of classes within a department and progresses to the status of a 'service' department, may become fully established in its own right especially where industrial conditions in the region favour it. In this there is some parallel with the evolution of the professional institutions, and the clearest example is physics. Chemistry and physics are largely common in origin but chemistry rapidly developed wide industrial applications and quickly became more fully organised. The Royal Institute of Chemistry was founded in 1877 and the Institute of Physics in 1920, foundations which reflect and have greatly influenced the subsequent development of these sciences at large and in the technical colleges. The Institute of Biology was established in 1950, and we may expect it and the others to show phases of development similar to those described in the 'National History of Learned and Scientific Societies' by Professor John Cohen *et al.* [5]. In 1954 the Royal Institute of Chemistry had 13,651 corporate members (4,354 Fellows and 9,297 Associates) and 2,714 registered students, while the Institute of Physics in 1954 had 2,806 corporate members (979 Fellows, 1,853 Associates). In the colleges, chemistry departments greatly outnumber physics departments which until recently have tended to be purely service departments. Now, with the rapid development of applied physics in industry, they are rapidly becoming established in their own right at Undergraduate and Higher National Certificate level, and in post-graduate courses on lines similar to those in chemistry and in the technologies.

The sciences may be regarded by the technologists (or at least by the students) as a regrettable necessity, or as a prime source of much of the power and development of their technology. With most students the former is generally true especially in the earlier years of study; mathematics is not greatly beloved of engineers, far less chemistry, which plainly offends their nostrils. No engineering student wants to be a chemist, but this attitude towards chemistry is shortsighted and may be caught from the engineering or works staff, or it may be aggravated by lecturers in chemistry obsessed with their subject to the exclusion of the quite legitimate needs of engineering students. This is a particular illustration of the problem of balance and interest as between main and ancillary subjects; it is found also with chemistry students who regard physics and mathematics as regrettable necessities despite the greatly increased significance of physical chemistry.

Assuming that with good teaching and with good influence at work these resistances are removed, there still remains another which is particularly interesting. It is a fact of examinations that mathematics tends to be the determinant of success as an engineer, that is, unless the student can pass in mathematics, in which he is less interested and possibly less able, he is denied the opportunity of ever becoming a qualified engineer. And there is a lurking uneasiness that this may be the cause of more loss than gain, with irritation at the failure of 'chaps who are very good on the job', as seen by the middle-aged engineering director who also remarks, 'I'm glad I got qualified when I did; just in time I reckon. . . .' Sir David Pye, F.R.S., makes the point in provocative terms:

> I would suggest that this selection is in danger of being left too much in the hands of the mathematicians. Some chemistry and physics may form part of the qualifying examination, but it is the candidate's ability in tackling the mathematics that is often crucial. Mathematical tests are ideal from the examiner's point of view; easy to set and easy to mark; producing a definite order of merit, easily translated into first, second and third-class honours. But indicative of what? Not, certainly, of the seeds of a creative or instinctive engineer. The mathematical test contains no element whatsoever of the positive approach to engineering education that would from first to last place *some* emphasis upon the ultimate aim of the engineer; which is to devise and construct [6].

This is not only so with engineers, for there is a definite apprehension that success in physics and/or mathematics is the determinant of a student's opportunity to become a chemist or even a chemical laboratory technician. While a certain minimum level in ancillary subjects is necessary, it is arguable that they should not be set at a level approaching the main subjects. This, though probably desirable for research workers, is a doubtful requirement for most students and the main run of occupations. As emphasised in Chapter VII on Selection and Placement there is a great need for research in such matters.

The foregoing considerations apply in greater or lesser degree to all the sciences which are now to be treated on an individual basis. In consequence the general range of work is discussed in each case, and not simply that occurring at a particular level such as in a regional college or local college of further education. The science courses have expanded greatly since pre-war days, and especially for London University degrees, the Associateship of the Royal Institute of Chemistry, and most markedly in the development and introduction of National Certificate courses; this latter development is shown in Diagram 28 (p. 426).

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Chemistry

The ubiquity of the chemist throughout industry is remarkable, whether he remains as a pure chemist during his working life or becomes a technologist through experience and further training, or an administrator in charge of industrial firms or educational institutions. From the general standpoint of chemists, therefore, the trend has been steadily away from too early a specialisation in his education for a particular technology or the needs of a single industry. The aim is to provide an all-round training in theoretical techniques and general experimental methods, an aim which applies largely to part-time as well as to full-time students. This is reflected in the award of 637 Higher National Certificates in Chemistry in 1954, compared with only 16 in Applied Chemistry.

The study of chemistry forms a major part of the education of chemists, chemical engineers, technical assistants for works and research laboratories and process workers in the chemical industry (p. 398). Part-time courses (day and evening) are available for all these, though only recently for the last group, and full-time courses are available for the first-named groups. The full-time courses lead to the London University B.Sc. (Special degree in Chemistry) and/or to the Associateship of the Royal Institute of Chemistry (A.R.I.C.). Part-time courses lead to the same qualifications, but increasingly those who study for the A.R.I.C. take the Ordinary and Higher National Certificates in Chemistry on the way. Provided the student has satisfied the Royal Institute of Chemistry in respect of other regulations for admission he may be ready sit the A.R.I.C. examination two or three years after H.N.C.

This very lengthy part-time course can be reduced with great advantage all round, by transfer to a full-time course at the H.N.C. level or preferably at an earlier stage. Representatives of the Royal Institute of Chemistry and the Ministry of Education have discussed such transfers, and the Institute's Annual Report, 1953, notes that 'The Institute has made known its views on the desirability of selecting a number of the more promising part-time students at both O.N.C. and H.N.C. levels for transfer to full-time A.R.I.C. courses. The Ministry is particularly interested in transfers at O.N.C. level and experience is now being gained through the operation of the Technical State Scholarships Scheme. The Ministry has affirmed that, for the purpose of the award of Technical State Scholarships, the A.R.I.C. is accepted as an alternative objective to an honours degree.' Local Education Authorities also make grants for this purpose, though some ought to note the implications of the preceding sentence and also accord them equivalence to university awards (p. 525).

In the past the O.N.C. in Chemistry was an end in itself for most students, but this is no longer so. Indeed it is dubious whether it should be so, as it is important at this stage to build up the ancillary subjects. There is thus much controversy about the inclusion of physics and mathematics throughout the O.N.C. course, which inevitably means postponing some of the chemistry to the H.N.C. course and reducing, so it is alleged, its appeal and effectiveness to chemistry students. Without their inclusion the scope of the physical chemistry possible in the H.N.C. is severely restricted. While two self-consistent schemes can be devised, that with a minimum of physics and mathematics in the earlier stages is inevitably inconsistent with modern needs at the H.N.C. stage.

The Higher National Certificate is an important stage and the aim should be a good basic knowledge of chemical reactions and the conditions affecting them, and not a passing acquaintance with complicated syntheses or structural theory.

The parallel to the foregoing schemes are the National Certificates in Applied Chemistry taken at the Higher stage, especially in a selected branch of chemical technology, including the application of underlying scientific principles and of suitable cognate subjects. Examples of these technologies are textile processing, leather manufacture, petroleum refining, papermaking, paint and varnish manufacture, brewing, cement manufacture, dyes and intermediates, fertilisers, oils, fats and waxes, rubber and refractory materials. Despite the apparent opportunity afforded by all this variety, only 18 O.N.Cs. and 16 H.N.Cs. in Applied Chemistry were gained in 1954 as compared with 937 O.N.Cs. and 474 H.N.Cs. in Chemistry. The ambitious student is not unaware that the latter is a far more acceptable route to the A.R.I.C. than is the H.N.C. in Applied Chemistry. The latter is not so regarded by the Institute as it is thought that the more technological aspects should be deferred until after the H.N.C. stage.

A student, whether full-time or part-time, can study for the A.R.I.C. examination only at a college which is recognised by the Royal Institute of Chemistry for the purpose. This recognition is granted only after inspection and careful consideration of the staffing, equipment and facilities available. In 1953-4 there were 63 colleges recognised (excluding universities), but in 1952–3 only 47 had successful candidates in the examinations, these results being inclusive of full-time and part-time students. In 1952–3 the A.R.I.C. was gained by 179 students (out of 615 candidates) of whom over a third (34·6%) were from three colleges only and over two-thirds (68%) from 15 colleges, that is two-thirds of the passes from about one-quarter of the colleges submitting candidates. Twelve colleges submitted 38 candidates but gained no successes, while another 12 colleges gained one each out of a total of 69 candidates sitting the examination. Such colleges have students taking degree and other examinations, but these results do not include them: they are however not results solely of a 'bad year' but follow well-established trends, with the result that the Royal Institute of Chemistry itself has been closely investigating the causes for them.

The foregoing figures provoke speculation on important issues; the submission of ill-prepared candidates, due possibly to inadequate standards or to an unwise sympathy with the student 'having a go' if only for practice; the severity of the examinations especially in the rising standards required in physical chemistry; the great odds against students in part-time courses, especially evening courses, and the urgent need to transfer students to full-time courses; marginal conditions of recognition especially in range and quality of staffing, and the need to consider concentration of courses in regional colleges where such conditions can be fully justified and amply met. Moreover the post-H.N.C. stage leading to A.R.I.C. must be a strong all-round course required for professional training.

As a first measure a regulation has been introduced whereby a student cannot become a 'registered student' of the Institute unless he has obtained the G.C.E. Advanced Level in Chemistry, or the O.N.C. in Chemistry, or has passed an equivalent examination. The Institute has in mind the possible revision of its regulations for the Associateship, with a Part I examination from which exemption may be gained with a high standard in the H.N.C. examination in the three main branches of chemistry; a Part II examination which will admit to a new grade of non-corporate membership, the Graduate membership from which exemption may be gained by university graduates with approved degree in chemistry; finally, Graduate Members, after a period of approved professional experience, may be elected to the Associateship and thus become corporate members of the Institute. In all this there is a much closer resemblance than hitherto to membership of the professional engineering institutions. The Fellowship (F.R.I.C.) is the senior grade of corporate membership and revised regulations for this and for the introduction of Diplomas are also being introduced.

Assuming the successful solution of the problems enumerated above, there still remain the inherent hazards of examinations, and there is a good case for successful regional colleges being granted recognition for their own associateship examinations, subject to a system of external examiners on university lines appointed by the professional institution. This would give flexibility and allow the introduction of research topics in the final year.

The major colleges have well-established full-time courses for B.Sc. and A.R.I.C., and these not only make possible a fuller theoretical treatment of the various branches of chemistry, but also allow time for the introduction of modern practical techniques. On the side of methods of separation and determination of substances there are such methods as chromatography, electrophoresis, modern distillation practice, polarography, use of the cathode ray oscillograph; on the synthetic side there is time to determine more closely the factors affecting yields of reactions and to apply modern methods to this end.

These departments have also well-established and growing facilities for research usually leading to the M.Sc., and Ph.D., degrees of London University. The Department of Scientific and Industrial Research gives grants for approved research in major colleges (p. 196), and an increasing number of firms are co-operating with awards of scholarships and grants, the loan of equipment and supply of materials for research problems.

Post-graduate courses are being increasingly held on lines already discussed (p. 125). There is a wide field for development of these in relation to industrial chemistry, and the following are examples of recent courses; The Chemistry of Synthetic Dyestuffs, Recent Developments in Chemical Techniques, Reaction Kinetics, The Design of Experiments, Statistical Analysis of Experimental Results, Surface Chemistry, Chemical Hazards of Industry, Bio-Chemical Processes with Special Reference to the Use of Isotopes in their Elucidation, The Design and Operation of Fractional Distillation Plant, Recent Advances in Inorganic Chemistry.

In addition to all the foregoing, chemistry is an ancillary subject for full-time diploma and degree courses in various technologies, e.g. mechanical and electrical engineering and is a main essential in chemical engineering and gas engineering. It is also provided in courses for the Goneral Certificate of Education at both Ordinary and Advanced levels. Applied chemistry forms an important ancillary in other technologies such as building, textiles, leather, plastics, rubber ceramics and in such crafts as bakery, catering and other subjects mentioned in Chapter XIII. The teaching of chemistry to such a wide range of students and courses poses a real challenge to the teaching staff in their sympathetic understanding of students, and in the administrative problem of dovetailing staff timetables into those of many other departments; this should not be on the basis of any member of the chemistry staff being available at the time, but the more difficult solution of allocating the teacher most interested in the particular subject and class (Chapter XVIII). The volume of advanced teaching in a major department can be large, for example, in one such department in 1953-4 there were 233 students taking part-time post-graduate short courses, 405 students of chemistry taking courses for B.Sc., A.R.I.C., and Higher National Certificate in Chemistry examinations (with some 260 up to O.N.C. level), and 450 students from other departments also take chemistry classes during the session.

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Physics

The rapid development of physics, especially in such spectacular fields as radar and atomic energy, has led to some confusion as to what it comprises; for radar is inseparable from electrical engineering, as also are radio and television, while the development of atomic energy is impossible without chemistry and chemical engineering. It is well, therefore, to realise that the work and training of most physicists come largely within the following description or definition of physics: 'the science or sciences, treating of the properties of matter and energy or of the action of the different forms of energy on matter in general (excluding Chemistry and Biology)'. The exclusion is specially interesting in view of the growing importance of physical chemistry and bio-physics. Some research physicists are concerned to discover the nature of the matter and energy, but the majority are concerned with their interaction as defined above. For this reason, physics has been more concisely defined as the science of measurement; not simply the act of measurement which is, of course, the basis of most scientific work. For this reason alone physics penetrates into many industries, and it is often an accident of historical development whether the term chemist or physicist is applied rather than which is the more appropriate. Another aspect is that there is no 'physical' industry as there is a chemical industry, but physicists are employed on a very wide range of industries, for example, the chemical engineering and food industries, in textiles, ceramics, radio and television, telephones, atomic energy, the industrial research associations and Government Departments. Teaching posts are available in schools, technical colleges and universities, and research is undertaken, especially in the universities.

Prior to the war the physics taught in technical institutions was almost exclusively as an ancillary subject. Since the war there has been the development of physics in full-time and part-time courses for the General B.Sc. London External Degree, and later for the B.Sc. Special Degree in Physics. In 1952 the number of B.Sc. Special Degrees (External) in Physics gained from technical colleges was 45 compared with 211 similar degrees in chemistry. It is now customary for special degree students first to take the General Degree either in physics, mathematics and applied mathematics or in physics, mathematics and chemistry. This gives them a better basis, a penultimate qualification, and facilitates the staffing of small groups of students.

The major post-war development has been the establishment (in 1945) of the Schemes for Ordinary and Higher National Certificates in Applied Physics, the partners being the Institute of Physics and the Ministry of Education (p. 154). This now forms a valid route to professional status, and students who gain the H.N.C. at 'Credit' standard may become Graduates of the Institute on passing two further specified papers of the graduateship examination. This additional requirement is made also of students who gain a General Degree at Pass standard, but complete exemption is given to holders of the General Degree at Honours standard or a Special Degree in Physics. Colleges are recognised by the Institute after inspection and consideration of staffing, equipment and facilities (as is done with chemistry, p. 432) for courses leading to the graduateship and in 1954, 43 colleges were so recognised. In comparison 35 colleges have courses for the General Degree in Physics, and 25 for the

Special Degree (these colleges also have the graduateship courses).

Besides physics, mathematics, chemistry, workshop practice and drawing, the specialist subjects dealt with in the Applied Physics courses will vary with the industries in the locality or region served by the college. Typical subjects are the following: Industrial Temperature Measurement, Photometry and Illlumination, Vacuum Technique, Rheology, Strain Measurement by Optical and Electrical Methods, Spectroscopy, X-ray Diffraction and Radiography, Electronics.

The number of students taking these courses will probably continue to increase, and they may cater increasingly for students who are not suited for the special degree in physics but for which they enter at present for reasons of prestige. It is also too early yet to judge the future, but comparisons with chemistry are and will be inevitable; it is noteworthy that whereas the H.N.C. in Chemistry has hitherto not been linked with the A.R.I.C. (but see p. 433), yet since the war has become, *de facto*, a route to it, the H.N.C. in Applied Physics is officially a recognised route to Grad.Inst.P. and thus to A.Inst.P. Bearing also in mind the experience with H.N.Cs. in engineering and their link with graduateship of the professional institutions, we may expect the value of the H.N.C. in Applied Physics to become readily and widely appreciated. The Institute of Physics is especially interested in applied physics, particularly in industry, and has done much to promote the status and development of physics in technical colleges. In 1954 its total membership was 4,296 (979 Fellows, 1,853 Associates, 953 Graduates, 511 students).

Post-graduate courses and research are well established in a very few colleges, and there is need for a much greater development especially in applied physics. As with chemistry both industry and the research associations can help greatly in this development. Examples of post-graduate courses are the following: Non-destructive Testing, High Vacuum Practice, Photographic Methods in Physics, Laboratory Techniques, Recent Advances in the Physics of Semi-Conductors.

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Mathematics

As the practical science of measurement, physics may be strongly contrasted with pure mathematics which is the abstract science of quantity, including geometry, arithmetic, algebra and other cognate studies; applied mathematics occupies a position intermediate between the two as comprising those branches of research and study which consist in the application of this abstract science to concrete data. There is indeed an intimate relationship between mathematics and the physical sciences, which led Emmanuel Kant in the eighteenth century to dogmatise that no subject could become a science unless it was capable of being treated mathematically. So strict a requirement would be resisted by those concerned with the biological and social sciences, though the application of mathematics to these sciences has been an outstanding feature of the last century. For examples we may note the statistical design of agricultural experiments from the time of Gilbert and Lawes at Rothampstead, the development of the embryonic Mendelian science of genetics into the science of biometry, the development of psychology and demography from the work of Francis Galton onwards. Nowadays the statistical basis of insurance and market research, of Gallup Polls and productivity control are but some of the high-lights of mathematics in the modern world. These show, as Hogben suggested, 'that Mathematics is still the Mirror of Civilisation', even in the hopeful misapplications of the permutations of the punter and the p(f)ools.

Parallel with the rapidly increasing and diversified applications of mathematics, in both peace and war, has come an increasing public interest in the subject, with such modern publishing phenomena as Lancelot Hogben's *Mathematics for the Million* and W. W. Sawyer's Pelican book *Mathematician's Delight*. Both are concerned to dispel the dread or distaste of mathematics which is still widely prevalent, even among the students in our colleges. Hogben attempts to provide social and even political reasons for the exclusiveness of mathematics but, whatever the cause and whenever it has the greatest effect—in school or in college—it is still with us and hampers the work in the colleges and, by cumulative effect, the competence of students in their chosen main subjects also. The mathematics department in the technical college may be concerned with teaching students in a wide variety of courses, from the most elementary craft courses to final honours special degree in mathematics, a range which, as with the science staff, calls for exceptional ability and sympathetic understanding. The level of mathematics in each case is perhaps dictated more by the minimum requirements of the main subject (e.g. mathematics for building, engineering and physics respectively) at the various levels, and less by the average ability of students taking the particular classes. But to the practising teacher the reverse seems to be true, that the student's ability and interests do not reach even to the limited heights required. How far this is compounded of limited innate ability and of cumulative defective education is hard to say, but it is a problem more apt to afflict the mathematics teacher than his colleague who teaches the main subjects.

There is a growing number of post-advanced courses in mathematics which, generally speaking, are not post-graduate courses for professional mathematicians to take higher degrees such as M.Sc. or Ph.D., but special courses to meet the needs of science and engineering graduates employed in industry who need more intensive mathematical training for particular requirements or developments in their work. Such courses include work in Statistics; Laplace Transforms; Numerical Methods; Matrices and Tensors.

The question of research for mathematics staff in technical colleges has hardly been raised, but it is no less important, in its stimulating effect on staff and students alike, than for the other departments teaching to an advanced level. Research in pure mathematics is not to be despised or debarred, for numerous examples exist to show its later usefulness in scientific applications, and it may be conducted in conjunction with the staff of the neighbouring university. Mathematicians may also join with great advantage in technological and scientific researches in other departments, and also in 'operational research' in various fields.

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Metallurgy

To the traditional metals such as iron and copper, silver and gold, modern science has added the light metals, and a complicated range of alloys designed to have advantageous properties for special needs such as lightness with strength in aircraft, resistance to corrosion in chemical plant and cutlery, great hardness with resistance to 'creep' under arduous conditions, as in rails and in jet engines. Metallurgy covers the art of extracting these metals from their ores and adapting them to the various processes of manufacture.

The services of the metallurgist are essential at all stages of extraction and manufacture, in controlling and improving processes, in determining the properties of the metals and alloys as they are prepared, and in research in predicting and preparing new alloys to meet the exacting specifications of the engineer or designer. He can choose between two great groups of industries—the iron and steel industries, and the non-ferrous industries within which there is an immense diversity, from copper manufactured and alloyed by the thousands of tons to platinum by the ounce, and from the purest forms of metals such as uranium (used in atomic piles) to complex alloys for highly specific purposes. He may also enter teaching at a technical college or university, or conduct research thereat, in a research association, or in the individual firm, and if his interests and other qualities justify it, he may, like other scientists, rise to the top ranks of management.

Education, as with other sciences, is provided through the universities and the technical colleges. Full-time degree associateship courses in metallurgy are provided in London at the Battersea Polytechnic, S.W.11, and the Sir John Cass College, E.C.3, at Birmingham College of Technology, Manchester College of Technology, and the Royal Technical College, Glasgow. Chemistry and physics are the basic subjects required for metallurgy and graduates in these subjects can subsequently acquire metallurgical training. Full-time courses in metallurgy are also held in the technical colleges at Birmingham, Coventry, Enfield, Rotherham, Smethwick, Wednesbury and Wolverhampton. Some are on the 'sandwich' basis as for the Higher National Diploma at the Constantine Technical College, Middlesbrough.

For the part-time student employed in industry there is the recently established system of National Certificates in Metallurgy (p. 156) which forms an important route to professional status, as the Higher National Certificate gains exemption from appropriate subjects of the Institution of Metallurgists' examination for the Licentiateship, thus leading towards the Associateship (A.I.M.). The Higher National Certificate courses are held at the foregoing technical colleges and at Bradford, Chesterfield, Corby, Enfield, Newport, Nottingham, Scunthorpe, Shotton, Swansea and Workington. These and other colleges also provide part-time courses leading to the City and Guilds Final Examinations in Metallurgy, the Iron and Steel Operatives' Course, the Operatives' Course in the Manufacture and Treatment of Non-ferrous Metals Finishing including the Electrodeposition of Metals.

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Optics

Education and training to become ophthalmic and consulting opticians is provided in three-year full-time courses at a few technical colleges, notably at the Northampton Polytechnic, which has provided over 68% of the total number of successful candidates in the last two years. After two years' study in applied optics, ophthalmic subjects and related sciences, the third year is largely clinical practice but includes also the study of pathological conditions, orthoptics, and industrial ophthalmic optics as training for the Final (Part III) examinations. In the Northampton Polytechnic third year the equivalent of three days per week is spent at the London Refraction Hospital when practice in the refraction and orthoptic clinics, the use of drugs and the recognition of abnormal conditions is obtained. The London Refraction Hospital founded in 1923 is managed under a scheme ordered by the Charity Commission, and financed and staffed by the optical profession.

The first year covers the ground for the dispensing certificate of the qualifying examinations and the Preliminary Dispensing Examination of the Association of Dispensing Opticians, and the final professional examinations normally taken are those of the bodies listed below. Full-time courses are also provided at Bradford, Cardiff, Edinburgh (Heriot-Watt College), Glasgow (Stow College), Manchester and West Ham. Part-time courses are held at Belfast, Birmingham, Bradford and West Ham.

REFERENCES

The British Optical Association (p. 619).
The Spectacle Makers Company, Apothecaries Hall (p. 620).
M.L.N.S. Careers Pamphlet, No. 34, *Optics and Orthoptics.*

Photography

The applications of photography are legion, ranging from studio portraiture, cinematography, commercial photography and photolithography to the most recondite uses in the advancement of knowledge as in the investigation of cosmic rays. A great deal of scientific work would be brought to nought or made immensely difficult and many a criminal would have escaped detection without the use of photographic methods.

Training in photographic processes is thus essential for many laboratory technicians in all kinds of laboratories and industries, the printing and cinematographic industries, and for photographic studio processing work. Part-time courses of training are provided in a number of colleges leading to City and Guilds Final examinations which are in two sections, I: Principles and Scientific Applications of Photography. II: Portraiture and Commercial, Industrial and Advertising Photography. A Full Technological Certificate is awarded on passing both parts at certain standards and on other conditions. Such courses are provided at the Harrow Technical College and School of Art situated as it is near to the works of Kodak Ltd., and the course started in 1936 at the South-east Essex Technical College, which is similarly situated near to the works of Ilford Ltd., is to be re-established.

The Polytechnic, Regent Street, W.1, has a department which provides long-established full-time courses in photography and for ciné-technicians, and other well-known centres are Guildford School of Art and Ealing School of Art.

REFERENCES

The Royal Photographic Society (p. 620).
Institute of British Photographers (p. 620).
'Photography as a Career', by a Correspondent, *Times Educ. Suppt.*, 13th August, 1954.

Biology

Biological subjects taken in technical colleges at advanced level are mostly ancillary to chemistry for the B.Sc. London Special Degree in Chemistry, or as part of a degree or diploma course in pharmacy. Comparatively few students take it as a subject in the General Degree and still fewer take the B.Sc.

Special Degree in Botany or Zoology. It is also taken as a subject for the General Certificate at Advanced Level, especially by students desiring to enter courses for pharmacy and medicine.

Nevertheless though this represents the bulk of the work it does not quite represent its potentialities. For biology is steadily becoming more important in certain industries and there is a consequent increasing demand for the services both of professional biologists and of suitably qualified technicians. Two recent developments may therefore be specially noted. The first is the establishment in 1950 of the Institute of Biology for the professional representation of biologists, with a membership of 900 drawn from biologists in universities, technical colleges, schools, hospital and industrial laboratories, research institutions and the scientific civil service, and some 200 student members. Already it has been very active in promoting education through conferences, and is now concerned with the second development, that of establishing a scheme for National Certificates in Biology. In 1955 its membership is 1,150 full members, 60 probationer members and 299 student members.

REFERENCES

The Institute of Biology (p. 617).

Biology, Agriculture and Related Sciences, Ministry of Labour Technical and Scientific Register Report (H.M.S.O.).

Biochemistry

Courses in biochemistry are held in a few major colleges, mainly allied with industrial processes. Thus there are courses at the Heriot-Watt College, Edinburgh, for the study of biochemistry (Fermentation Industries) leading to the College Associateship in Technical Biochemistry or in Brewing and to that of the Institute of Brewing. Other examples are the courses in industrial biochemistry and in the Chemical Technology of Fermentation Processes (including Brewing) at the Manchester College of Technology, and the short courses on special topics at the Sir John Cass College.

REFERENCE

The Institute of Brewing (p. 617).

Pharmacy

This ancient art has undergone almost as great a transformation in character and quality as that from alchemy to modern chemistry, and this is borne out in the greatly extended training requirements to-day. These are laid down as statutory requirements, as there is grave responsibility for the care, use and issue of poisons and dangerous natural and synthetic drugs, and the regulations are determined by the Pharmaceutical Society of Great Britain. Students must be registered with the Society from the outset of their training, and must complete a period of pupilage or practical training before they can be admitted to the Register of the Society as qualified Pharmaceutical Chemist (Ph.C.).

One arrangement comprises a one-year full-time course for the Intermediate examination followed by a two-year period of practical training in a pharmacy, after which the student returns to college for a two-year full-time course of study in pharmaceutics, pharmaceutical chemistry, pharmacognomy, physiology and forensic pharmacy. An alternative is to complete the three years' academic training followed by one year of practical training after passing the Ph.C. examination. Students who fulfil matriculation requirements of London University normally proceed to take the B.Pharm. degree in addition to the Ph.C. The B.Pharm. degree gives exemption from the Ph.C. examination except for the paper on forensic pharmacy.

Over these last 30 years there has been a great concentration of training into a limited number of centres and the following technical colleges now provide the major part of pharmaceutical education at the final stage to-day; Aberdeen, Birmingham, Bradford, Brighton, Bristol, Cardiff, Dundee, Edinburgh, Glasgow, Leicester, Liverpool, London (Chelsea Polytechnic), Plymouth, Portsmouth, Sunderland. The Intermediate examination is provided at most of these and at 57 other technical colleges.

Pharmaceutical qualifications lead to posts in general practice as assistants, managers or proprietors of pharmacies, posts in hospitals and laboratory posts in pharmaceutical manufacturing houses and in research.

REFERENCES

The Pharmaceutical Society of Great Britain (p. 619).
M.L.N.S. Careers Pamphlet, No. 36, *Pharmacy.*

Chiropody

Chiropody is concerned with the care of the feet and treatment of minor foot disabilities, in both its preventive and curative aspects. The training and registration of chiropodists is subject to the recognition and approval of the Board of Medical Auxiliaries, and recently the length of the full-time course of training has been increased from two to three years. Courses are held at the Chelsea Polytechnic, S.W.3, and the Royal Technical College, Salford, 5.

After qualifying, many students prefer to start a private practice of their own or they may purchase or assist in an established practice. There are increasing possibilities of employment as industrial firms are appointing chiropodists to their welfare centres. There are further possibilities under the Health Service, and the Ministry of Health now has the whole question of the recognition and conditions of chiropodists in the service under review.

REFERENCES

The Society of Chiropodists (p. 617).
The Joint Council of Chiropodists of Great Britain and Ireland (p. 617).

Laboratory Technology

This chapter cannot be completed without some reference to the indispensable work of laboratory technicians, which underlies the maintenance and development of so many of the courses delineated in this and preceding chapters. Increasing realisation of this in recent years led to the establishment of the Science Technologists Association, and with the support of the universities, the Royal Institute of Chemistry, the Institute of Physics and the City and Guilds of London Institute, appropriate courses of training are being established. These will lead to City and Guilds examinations and the schemes of training will be approved by the National Joint Committee on Recruitment and Training of Science Laboratory Technicians (Educational and Kindred Institutions), which has been set up by the Central Youth Employment Executive of the Ministry of Labour and National Service.

REFERENCES

Science Technologists Association. Secretary, c/o Chemistry Dept., Imperial College of Science and Technology, S.W.7.
The National Joint Committee on Recruitment and Training of Science Laboratory Technicians. Chairman, c/o Imperial College of Science and Technology, S.W.7.

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CHAPTER XV

HIGHER TECHNOLOGICAL EDUCATION

In all the wide-ranging controversy in education since the war the problems of higher technological education have had perhaps the most unremitting discussion; so much so that the current apologia for any new suggestion or worse, for any insipid re-hash of former hopes as the policy of despair, is to say 'We've wasted five or more years and we must do somesomething or else . . . !' Certainly this has been true of much policy making on the technical college side, while the universities have been empowered to develop in their own self-contained relatively unhampered way [1, 2].

Despite long continued disunity and consequent erratic progress, there has nevertheless been a most impressive unanimity about the critical importance of higher technological education in the post-war world, and on three main grounds. The first is the need for a great increase in the numbers of technologists to be trained, the second is the concern for deepening the scientific basis of their training in order to secure greater competence and usefulness in a wider range of industries, and the third is an equal concern for their broader education, and for fostering the personal qualities and human understanding indispensable to good management.

In contrast to this unanimity over these aims have been the sharply differing opinions as to where the shortcomings lay, and about the means to end them. Thus over the last two points has raged the controversy on the alleged evils of specialisation. The universities blame the schools for too early a specialisation and insufficient general education, and the schools defend themselves partly by pointing to the high specialisation required to gain university scholarships, and partly by insisting anyway on the value of specialisation at sixth form level in providing an indispensable intellectual discipline not gained in any other way. They insist, moreover, that for the able pupils this need not exclude a wide interest in other things and an active participation in general school activities. The universities are blamed by industry for not producing enough specialists capable of immediate use in industry because of their specialist training, of not producing full-grown men instead of specialists with inadequate personal qualities, and of producing too many arts graduates difficult to assimilate in industry, yet whose education has included much of these subjects and influences, the lack of which has been deplored in the training of the specialists. The technical colleges are accused of producing narrowly trained specialists from full-time courses indistinguishable from many a university full-time course and, with more justification, from rigorous part-time courses, with the means of transfer from them to ampler full-time and sandwich courses being provided all too slowly. Industry's complaint as to narrowness is accompanied by an undoubted reluctance on its part to see general education or general studies introduced into such courses, especially part-time courses; while industry has raised no organised protest, and scarcely a voice, against the material conditions which deny the opportunities and general social facilities to an increasing number of students, and which thus prevent the fostering of those very qualities which industry is insisting to be of ever-increasing importance.

At the root of most of this and other controversy is the problem of defining an agreed basis of discussion. Before dealing with factors affecting recruitment and with post-war proposals, an attempt will therefore be made to define and deal with three fundamental issues, namely, the problems of distinguishing between technological, technical and craft occupations, and education for them in the universities and technical colleges respectively, the post-war demands for technologists and, thirdly, the ability available in the population to meet these demands.

Definitions

We may base our discussion on the following definitions of technology and craft from the Oxford English Dictionary:

Technology: the scientific study of the practical or industrial arts.
Craft: skill, art, ability in planning or constructing; a calling requiring special skill and knowledge; especially a manual art, a handicraft.

The centre of poise, the fulcrum of the definition of technology is in the scientific study, while with the craft it is in the exercise of a skill or technique, a way of doing things [3]. The fundamental requirement of a technology is that an exacting scientific discipline must be undergone by the student, a discipline which gives mastery of the theoretical concepts required for widely differing practical ends. The Percy Committee Report asserted that 'Every technology is both a science and an art. In its aspect as a science it is concerned with general principles which are valid for every application; in its aspect as an art it is concerned with the special application of general principles to particular problems of production and utilisation' [4]. In a technology, science issues as a practical application into an external world extremely complicated by variables and factors which are rarely if ever under the technologists' or anyone else's complete control. These include the incomplete knowledge of raw materials and supply, of materials of construction, in design and the rate of change of design, of labour, and of the state of the market for all the foregoing. The problems of production and utilisation can be solved on a deadline only by the exercise of an art which is nurtured largely through cumulative experience in similar situations.

The difference between technological education in the universities and technical colleges is thus one of the timing or phasing of these two elements—the science and art of technology. In the universities the phasing is largely scientific, with the art phase introduced mainly as a pre-undergraduate year, some brief intermittent phases of vacation experience through several years and a thorough post-graduate phase. The technical college is mainly concerned with phases which are more interrelated either in day-release courses, where two phases are virtually concurrent, or in sandwich courses where large phases alternate over some years. It is foolish to argue that either method is wholly valid to the exclusion of the other; both combine the science and the art, but with different emphasis, and each is preferable for different types of students who are not thereby superior or inferior as potential technologists [3, 5].

Sir David Pye, F.R.S., in his Presidential Address to the Institution of Mechanical Engineers, made some very pertinent remarks on 'The Art of the Practical Engineer' [6].

> Before he can become an Associate Member of this Institution, the university graduate must have supplemented his theory by practical training and responsible experience, and this combination may provide the basis for his becoming a real engineer. But I have been led to feel how small a part of the way all the theoretical training, in which we teach him to manipulate formulae on paper and to record experiments in a laboratory, can ever take him; by the time he has 'grown up' as an engineer, indeed, his book learning will have become hardly more than a vaguely-felt background to his experience. For the art of engineering includes a very great deal that lies outside of formulated theory. The rule

> of thumb plays, and will always play, an important part; and rules of thumb are accumulated by experience.

Or again:

> The atmosphere of a laboratory is fundamentally different from that of a design office, which ought to be more like an artist's studio or an architect's *atelier*. In a design office, things are not right or wrong, trial and error lead gradually towards the best compromise in the special circumstances. And since compromise is fundamental in the solution of almost every engineering problem as it occurs in practice, the student at some stage should be made familiar with it. There is a real danger in concentration on the 'examples class'; admirable as it is for testing the understanding by a student of what he has been taught and for the exposure of muddled thinking. But deadening to originality of thought. In working out examples the student employs well taught mathematical techniques to find the solution of problems that are analogous to those in engineering, but different in form from those encountered in practice.

As 'walking the wards' and residence in hospital provide the beginnings of the doctor's clinical art, so experience in industry is essential to the technologist; this should not all be post-dated to the post-graduate stage, but should grow over the years, preferably in close relation to theoretical teaching, and therein lies the justification and the proof of experience with part-time day and sandwich courses. The importance of this experience is specially noted by the University Grants Committee and there has recently been an increase in vacation industrial experience arranged for students [7]. At the 1953 British Commonwealth Congress of Universities, Professor Hutt is reported as saying 'Let the universities teach the why and allow life to teach the how' [8]. While this seems to be generally accepted as being true for the universities, they are finding it increasingly desirable to relate the 'how' of life to the 'why' by means of vacation experience. Sandwich courses and part-time day courses provide the 'how' as an integral part, the former in an amply related way, the latter now at the expense of the 'why' of modern technology.

A skill or craft cannot be competently exercised without a thorough knowledge of materials, but it need not be and probably will not be a fully scientific knowledge—otherwise there would be precious few craftsmen. Similarly, if every technologist had to be able to perform every skill, which he understood scientifically and could apply to problems of design, they would be equally rare individuals. Thus we have the contrast between the expert baker and confectioner and the food technologist, the expert welder and the designer of welded plant, the skilled chemical process operator and the chemical engineer.

Again, for the particular skill or craft, some scientific knowledge is desirable. Indeed much of the confusion between craft, skill and technique as between craftsman, technician and technologist has arisen from the growing necessity for more scientific knowledge and understanding all round. As for the baker and confectioner, it comes from the use of new materials, for aeration and consistency, for synthetic creams and the growing sophistication of food, which may or may not be a regrettable necessity of living in large cities. For the welder it arises, for example, from the use of new light metals and alloys, and the more stringent demands of modern design in the use of traditional materials. With the chemical process operator it is in the need for understanding (but not for designing) the electronic instrumentation of continuous processes, not to mention the more critical experimental conditions and the increased need to guard against new and subtler hazards. In the great majority of these cases the science is required so that the specific task can be performed more skilfully and with greater safety and not primarily as with the technologist to enable him to improve the efficiency and reduce the hazards of established processes and, more important still, to innovate and establish new processes, materials and services with the greatest possible efficiency and despatch.

Life is such that neither it, nor humankind nor its occupations can be subject to a single dichotomy, and even in subtler classifications there is always the special case which appears to modify or even invalidate such generalisations as these. Dr. H. J. T. Ellingham has emphasised this aspect thus:

> The distinction between the professional technologist and the technician has generally been drawn so that the former shall have a sufficient knowledge and experience of fundamental principles to be able to apply them to a wide range of new developments, whereas the latter needs only to be experienced in the use of established techniques while working under direction. But the line of demarcation is not always sharp and it is possible for individuals to pass across it, sometimes I suspect, in either direction [9].

We can all readily quote the traditional use of terms before the present impact of science, and the consequent separation of different levels of occupations based upon science in varying degrees. The clearest example is the use of the term in the City and Guilds of London *Technological* Certificates, which mostly do not signify a professional technological level of science, but that of the minimum necessary for competency in a craft. A few cases exist of where the City and Guilds Technological Certificate gives exemption from part of a professional examination but the general separation of these two aspects is justifiable. If the foregoing distinction between 'technological' and 'technical' education be sound and desirable, the description ought to be a Full Technical Certificate, but there would be many who would resist such a change if only for the very human reason that 'technological' sounds so much better than 'technical'.

There is one potent source of confusion in that 'One man in his time plays many parts'—not necessarily seven occupational ones, but perhaps student, craftsman, technician, technologist, administrator, and while he is in one stage he may well be preparing for another later stage. Thus his education may not, and probably will not, be wholly confined to his present or even his next stage—which is indeed a potent argument for a good general education. But we should not confuse the main requirements of each one of a series of occupations with the individual who passes and develops through them.

In view of the foregoing we are not here concerned with craft education, nor with technician education in which the proportion of science is reduced to the minimum possible, save in two respects. The first is that we must take care not to erect absolute barriers between occupations and education for them, which are the predilections of over-tidy minds so bent on classifying entrance to all courses in terms of G.C.E. requirements only. We should preserve that flexibility which visiting foreign educators admire, with escalation between occupations and courses, so that the best ability can be moved forward and upward from wherever it is found and at whatever stage it develops.

The second respect, to which we return later, is that only a minority of colleges will be concerned with technological as distinct from technician and craft education, but the majority will have a very important task of discovering latent talent and seeing that it is fostered and sent forward for full development where adequate resources are available. These cannot be available at all colleges for everyone—being all things to all men is a self-defeating outlook—and it is poor service to our students and to industry to try to provide the maximum number of places with the minimum provision in each.

We should be most careful to distinguish technological education at the undergraduate level from that at the post-graduate level. By the undergraduate level is meant technological education for the first degrees such as B.Sc.(Eng.), B.Tech. and also the associateship of some colleges or the Higher National Diploma gained on full-time or 'sandwich' courses of at least three years beyond Ordinary National Certificate, General Certificate of Education, Advanced Level, or equivalent. These courses should have a good scientific basis. Higher National Certificate courses of two years' duration only do not match up to this requirement, as is recognised in the conditions laid down for increased grant for advanced technology under the Ministry's Circular 255. A three-year course made up by adding a year of endorsement subjects (p. 157) barely meets this condition, as some, if not most, of these subjects are not of a higher standard than those taken for Higher National Certificate and in a fully organised course would be taken at a much earlier stage.

The post-graduate level first of all comprises research for higher degrees such as M.Sc., and Ph.D., for higher national awards (p. 578), and for the Fellowship of certain colleges beyond the College Associateship. Furthermore it includes the whole range of post-graduate/post-advanced courses of a highly specialised character held mostly in the evenings, but increasingly, as recommended by the Ministry's Circular 270, in the daytime with post-graduate release from industry. The description *higher* technological education is reserved entirely to this post-graduate work, and a great deal of confusion would have been prevented if this had been generally accepted. Not least would its acceptance profoundly affect many prevalent ideas as to the scale of provision of technological as distinct from 'technical' and craft education. It is a commonplace of university education [10] that teaching up to first degree standard cannot be stimulated to be of high quality unless the teachers are in contact with and able to conduct post-graduate research and courses in their chosen fields of study, and this is, or ought to be, an equally self-evident truism of technological courses in technical colleges. The teaching potential and facilities required to secure this are clearly very much greater than that required to make local minimum provision to first degree standard only in one or two subjects.

We may relate the two kinds of education, technological and technical to the broad classes of occupations in industry, namely:

a. unskilled occupations
b. semi-skilled occupations
c. skilled craftsmen and technicians
d. professional and managerial occupations—scientists, technologists, managers and executives.

'Technical' education is largely concerned with (*c*) and to some extent with (*b*), technological education is concerned with group (*d*), and it is pertinent to enquire as to what are the present numbers of groups (*d*) needed by industry as a whole, and severally for the different industries, and what are the likely trends in the future.

Post-War Requirements

The Percy Committee Report on Higher Technological Education, published in 1945, was the first of many post-war reports stressing the increased demand:

> The evidence submitted to us concurs in the general view; first that the position of Great Britain as a leading industrial nation is being endangered by a failure to secure the fullest possible application of science to industry; and second, that the failure is partly due to deficiencies in education. The annual intake into the industries of this country of men trained by the Universities and the Technical Colleges has been, and still is, insufficient both in quantity and quality. We believe that the industrial demand for such men will increase in quantity after the war; and the demand for higher quality, especially in certain categories, will become more insistent as the nation becomes more conscious of its need for technical efficiency. In particular the experience of war has shown the greatest deficiency in British Industry is the shortage of scientists and technologists who can also administer and organise, and can apply the results of research to development [11].

The Report gave estimated figures for engineering requirements and urged an 'energetic programme of expansion, both in accommodation and staff, which will tax to the full the resources of universities and the technical colleges, coupled with adequate arrangements for keeping a close watch upon the demand which this programme is interested to meet' [12].

This was closely followed by the Barlow Report, published in 1946, the chief recommendation of which was that the universities should double their output of scientists within the next ten years, with appropriate increase in financial grants both to the universities and to students to attend them [13]. It is specially notable that the Barlow Committee should assert that 'Even if the total student population in

British Universities were doubled, this country would still fall far short of a number of European countries and the United States of America in the relative provision which it makes for higher education' [14]. The Barlow Committee supported the Percy Committee's recommendation that full-time technological courses of degree standard should be developed at a selected and limited number of technical colleges, and stated that this development would not relieve the universities of a proportionate increase of technologists equal to that of scientists [15]. They further suggested that 'urgent consideration should be given to the development, preferably in university cities, of a few Institutes of Technology designed to maintain the highest standards of study and research' [16].

The first of these recommendations was met by the universities in half the specified period of ten years, not without severe growing pains and calls on the devotion of their staffs to meet the emergency. The expansion was possible because the Government of the day provided the necessary greatly increased funds required through the University Grants Committee [17]. The third suggestion of the Barlow Committee is slowly being implemented, first by the decision in 1953 to double the size of the Imperial College of Science and Technology by 1962. In July, 1954, the Chancellor of the Exchequer announced that increased resources would be made available through the University Grants Committee for further developments at Birmingham University, Leeds University, Manchester College of Technology and Glasgow Royal Technical College [18]. A further government statement was made by the Lord President of the Council, Lord Salisbury, in December, 1954 [19] confirming these plans and declining to establish the technological university so strongly urged by Lord Cherwell [20], Sir Francis E. Simon and others [21]. The Government also rejected the recommendations of the recent Report of the Parliamentary and Scientific Committee concerning chartered Regional Colleges of Technology (p. 578).

The second recommendation, despite the support of both the Committees, still awaits implementation. The Barlow Committee was convinced that 'When all possible measures have been taken to expand the output of graduates the nation will certainly be seriously short of scientists in 1950 and is unlikely to have an adequate supply by 1955' [22]. Related to this is the subsequent 'Note on Technology in the Universities' prepared by the University Grants Committee which says of its proposals 'that developments in the universities, on the lines discussed here, would leave for the Technical

Colleges a large and expanding field of work of great importance' [23].

Contemporary with these official reports, and continuing annually since 1947, are the important Reports of the Advisory Council on Scientific Policy [24]. The first Report expressed the view 'that the effective application of the results of scientific research by suitably qualified technologists is an even more urgent need than the furtherance of research itself, and would bring much quicker results' [24*a*]. This has been the recurrent theme of successive Reports. From 1949 to 1951 Reports were issued by the Ministry of Labour and National Service on the 'Present and Future Supply and Demand for Persons with Professional Qualifications' for example, in electrical, mechanical and chemical engineering respectively [25]. The Technical Personnel Committee Sub-committees collected their evidence about the potential demand mainly by questionnaires sent to industry, the Government and other employers. But although this kind of enquiry provides a good picture of the existing state of affairs it is not a wholly reliable guide to the future, for 'employers, when asked for their views reply cautiously on the basis of their known requirements, and by their very nature, estimates made in this way are unlikely to allow for a growth in the demand for industrial scientists arising from an increase in national productivity, nor for such unpredictable new commitments as rearmament. It is not surprising that several of the forecasts made by the Sub-committees need revision in the light of events' [26]. To this may be added the effects of such overseas developments as the Colombo Plan, and technical aid to economically backward countries [27].

The crux of the matter is the necessity for constantly repeated efforts to determine the need of scientists and technologists. But these are made less determinate and therefore more difficult by the cumulative and self-quickening effect of modern scientific developments themselves in requiring ever more trained people, of fluctuating economic pressure, and of the slow acceptance by industry of the importance of scientific training, caustically described by the Advisory Council in the following terms. 'The primary reason why our industry as a whole does not make more use of scientists (including technologists) is not because their numbers were, and are, insufficient, but because large sections of industry, being conservative and complacent, have neither missed nor asked for them' [28]. This is not true of all industry, as shown by the firms who compete for rising ability by whole-page informative advertisements in the *Manchester Guardian* [29]; or by those firms with enlightened training schemes, exemplified in Chapter VI and, for example, by Metropolitan Vickers Electrical Co. Ltd., with six out of seven executive directors and about 70% of all departmental heads having started as apprentices [30]. Nevertheless, the Advisory Council asserts that large sections are both conservative and complacent and, alongside this, for example, we may put Sir Raymond Streat's pungent comments in his Address to the Textile Institute in 1953.

> Not only do we need the best organisation, the best machines, and the best techniques, but we need in every department the best staff that it is possible to obtain. . . . The British textile industry is remarkably thinly staffed. My travels have taken me to almost all the major textile producing countries of the world and I have been forced to recognise that the ratio of staff in these countries is far higher than it is in this country. I have been particularly impressed by the number of able and highly trained young men who are being carefully groomed by our competitors for positions of responsibility [31]

This is one comment on one industry out of many and it is but part of a general adverse contrast with other countries, especially the United States, which was strongly emphasised in the Advisory Council's Fifth Report [32], following the findings of the Anglo-American Productivity Council Report on *Universities and Industry.*

The adverse comparison with Switzerland and other continental countries is pointed by Table 43 compiled by Professor S. T. Davies [33].

TABLE 43

DIPLOMAS AWARDED ANNUALLY IN VARIOUS COUNTRIES

Country	Population, millions	Civil Eng'g. and Surveying	Mech. & Marine Eng'g., Naval Arch., Aeronautics	Elec. Eng'g.	Chem. Eng'g. and Ind. Chem.	Mining and Metallurgy	Total	Number per 100,000
Belgium	8½	64	54–71–57 (M-E)		19	97	362	4·26
Germany (Federal)	47¾	830	700	530	?	350	2,410	5·05
Sweden	7	110	136	98	70	26	440	6·29
Denmark	4¼	110	80	60	60	—	310	7·3
Norway	3¼	58	42	16	30	13	159	4·9
Netherlands	10¼	179	194	74	67	24	538	5·26
Switzerland	4¾	114	125	111	109	—	459	9·66
Great Britain*	49	{450–154–578 450–960–578 (Gen.)		344 344	194 201	252 288	1,972 2,821	4·03 5·75

* For Great Britain, the category '(Gen.)' includes graduates whose degrees are unclassified within the branches of civil, mechanical and electrical engineering.

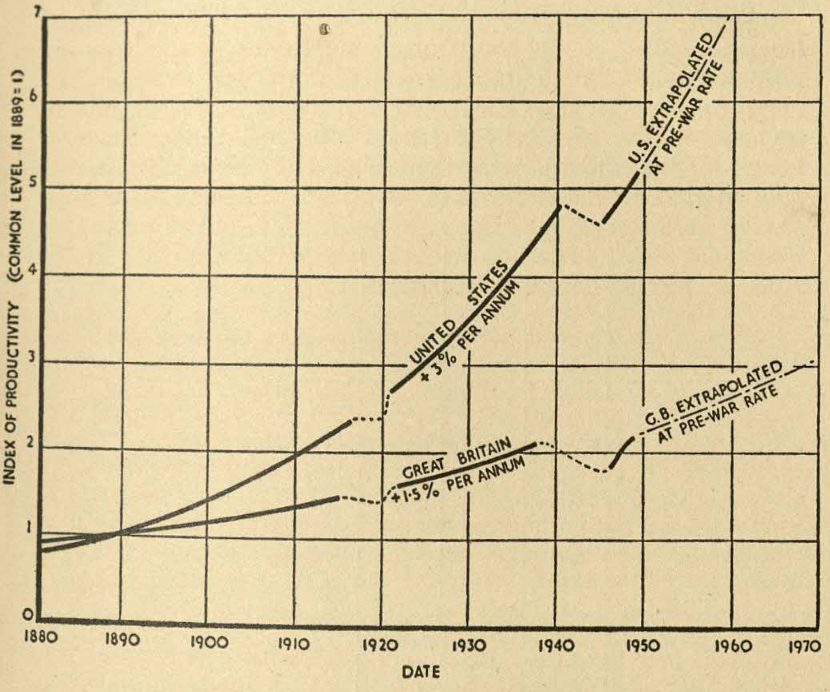

DIAGRAM 29. INDICES OF INDUSTRIAL PRODUCTIVITY (OUTPUT/MAN YEAR) FOR GREAT BRITAIN AND THE UNITED STATES

Data drawn from many sources, such as the *British and American Census of Production; British Annual Abstract of Statistics;* the *Economist;* papers by L. Orde and L. Rostas, etc. Where such data refers to hourly output, suitable corrections have been made to allow for the reduction in hours of work since the earlier years of the survey. Information with regard to the first forty years covered is very sparse, but it is believed that the general trend shown by the curves is in broad general agreement with the facts.

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The difference between this country and the U.S.A. was emphasised most strongly by Sir Ewart Smith at the British Association in 1950 [34]. A series of graphs of industrial production over many decades were compared with the graphs of the rising numbers of first degrees awarded in the same periods in the U.S.A. and the United Kingdom. Two examples suffice to show the basis of argument, and these are given in Diagram 29 and Diagram 30.

The broad analysis of industrial productivity for the United States shows that, although the output per head was approximately equal just before the turn of the century, the United States has increased at approximately 3 per cent. per annum (at a compound interest rate) whereas in this country the annual rate has been almost exactly half that figure. As a result of this difference, United States industry has now an overall productivity per head of those engaged in it of approximately 2½ times the corresponding figure in Great Britain. Although precise data are sparse for the earlier years, all the evidence supports this relative trend [35].

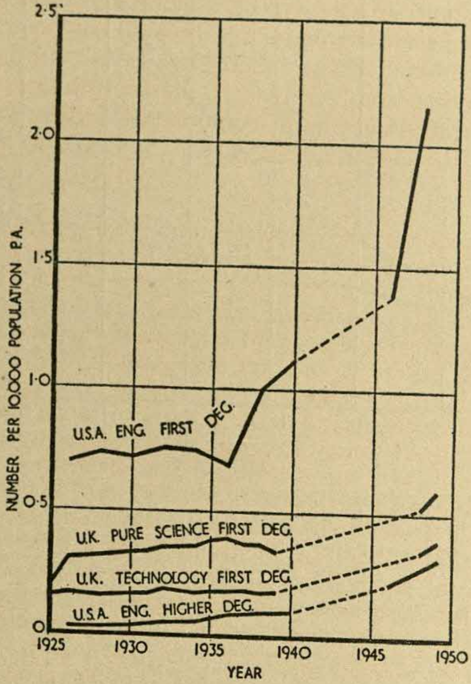

DIAGRAM 30.

TYPICAL TECHNICAL DEGREES (MEN).
COMPARISON OF U.K. AND U.S.A.

Sources: U.K. University Grants Committee Annual Reports. Statistical Abstract for the United Kingdom 1913 and 1924 to 1937. U.S.A. A. B. Bronwell, 'Journal Engineering Education', Vol. 39. No. 36, 1949. Statistical Abstract of the United States, 1932–48. Reproduced by permission of the Editor of 'The Advancement of Science' and of Sir Ewart Smith.

Sir Ewart Smith infers a direct relationship between the shapes of the two sets of curves in these graphs for the U.S.A. and U.K. respectively. He concludes that, inasmuch 'by world standards our objective should be to increase our overall national productivity by not less than 5% per annum for many years to come', we need a 5% rate of increase at compound interest of full-time degree students of science and technology. 'Although we have recently doubled our output after 25 static years, this does not make up our leeway, nor does it remove the need for continuing expansion in accord with the laws of natural growth' [36].

In taking the number of degrees as the indexes of the relative development of the systems of higher education in the two countries, a controversial assumption has been made as to the quality of the degrees which have been counted. It may be that the error involved in this assumption does not invalidate these differences and conclusions. But we ought to know what the differences are, or at least to make valid comparisons.

It would seem that the entry standards to degree courses are not less than one year below those to British degree courses and that the standards of the first degree are generally not higher than those of a British pass degree. Several professors with a knowledge of the British system went far beyond this and conceded up to a two-year difference in entry standards.

The range of American higher institutions is so great and varied that it is well to realise that the powers of conferring degrees do not mean quite the same thing in the two countries. There are about 1,890 institutions in the U.S.A. concerned with higher education and of these 1,294 confer degrees. The work of these institutions is accredited by certain associations and of the 1,294 degree granting institutions mentioned only 810 are accredited by at least one of six regional bodies; of these 810 about 330 are recognised by Associations of American Universities, but these include teacher training colleges and other institutions which in this country do not grant degrees. The most important accrediting association is the A.A.U., the Association of American Universities, which consists of some 32 graduate schools in the U.S.A. and 2 in Canada. The Educational Directory 1946–7 (U.S. Office of Education) lists 205 American chartered universities, accredited and unaccredited. Reference should be made to the standard work *American Universities and Colleges*, edited by A. J. Brumbaugh (1948 edition), which gives some 180 such institutions all accredited. In this context, it is a quite misleading act of British modesty to omit Higher National Certificates from any comparison with American degrees. Nevertheless, though reduced, the force of Sir Ewart Smith's argument remains powerful and we do well to give it urgent attention [37].

Nothing that has happened in the intervening years has invalidated this general conclusion [38]; indeed, the Advisory Council on Scientific Policy in its Seventh Report, 1953–4 re-affirms its previous conclusions in a review of its previous Reports [39].

In June, 1954, F. H. Perkins reviewed the scientific manpower situation [40] based on the following estimates of the Barlow Committee Report:

1950	Estimated requirement of scientists	70,000
	Estimated number available	55,000
	A deficiency of	15,000
1955	Estimated requirement of scientists	90,000
	Estimated number available	64,000
	A deficiency of	26,000

In other words, an increasing deficiency rising from 15,000 in 1950 to 26,000 in 1955+ which, if anything, was an underestimate.

Against this Mr. Perkins set the following very approximate figures for men pursuing courses in science and technology at the universities and at advanced levels in the technical colleges in 1952:

		Total	*Annual Output*
a.	In the universities	27,000	6,600
b.	In advanced full-time courses at technical colleges	10,420	3,000
c.	In advanced part-time courses at technical colleges	26,670	6,900

Whereas the Barlow Report figures were for science only, these figures are for scientists and technologists, including engineers.

Mr. Perkins then examined the development of such courses and future trends which he drew graphically in Diagram 31, showing that the 'Barlow' target was rapidly passed by the universities (p. 453), and that an even greater expansion took place in the technical colleges.

The greatest interest of Diagram 31 lies in the indication of future trends, appropriately terminating in large question marks. A further expansion of the output of the universities is indicated and recommended in the text of the paper, but this is not our prime concern, though it would raise internal problems of balance within the universities which have been and are likely to be the subject of acute controversy [66]. From the technical college standpoint the fall from (A) to (B) in part-time courses is a consequence of the early gathering of the best ability into full-time and sandwich courses

(p. 86), with the rise in their output from (C) to (D). The only comment which can be made, if the rise and fall are approximately equal in Diagram 31, is that it envisages an internal re-arrangement in present technical college enrolments, but no significant increase [40*a*]. Now the 1953–4 Report of the Advisory Council on Scientific Policy undervalues the present contribution of technical colleges, clearly shown in Mr. Perkins' paper (Diagram 31), putting it almost

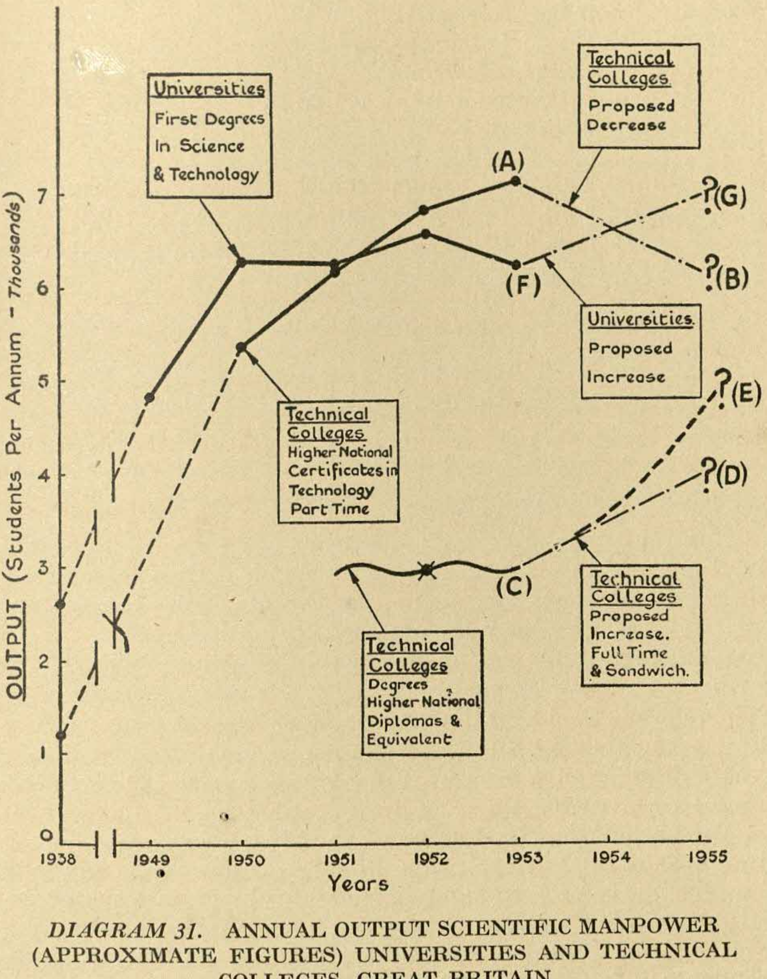

DIAGRAM 31. ANNUAL OUTPUT SCIENTIFIC MANPOWER (APPROXIMATE FIGURES) UNIVERSITIES AND TECHNICAL COLLEGES, GREAT BRITAIN

Reproduced by permission of Mr. F. H. Perkins. The original has been amended slightly by the additions of letters (A) to (E), and of the curve (C)–(E).

entirely in terms of Ordinary and Higher National Certificates, giving no specific indication of their contribution through London University degrees or through corporate membership of professional institutions (p. 194). It certainly underestimates their future contribution by omitting any mention of Higher National Diplomas and the encouraging growth of sandwich courses (Chapter III). What is required is a greater input of students, especially direct from the grammar schools into sandwich courses, so as to increase the output from (C) to (E) (this curve C–E has been superimposed on the original diagram to make this point). Only by some such marked development both in the universities, from (F) to (G), and in the major technical colleges can the ever-growing gap between supply and demand be bridged (p. 573).

Against this general consensus of opinion and estimate on the second fundamental issue of the demand for scientists and technologists, we have now to consider the third—does the ability exist in the population to meet these increased needs?

Ability in the Population

In view of the adverse comparisons cited above, especially in respect of the U.S.A. and Switzerland, it does not require a fervent nationalism to provoke the question whether the British people are any less deficient in native ability. Even the most cautious might reasonably conclude that it was rather a matter of opportunity. But it is wiser to look at this issue more closely, and examine such evidence as there is about the number of young people of good ability in the population from whom future scientists and technologists might be recruited.

The earliest post-war attempt to determine the reserves of intelligence in the population, posed in terms of the range of intelligence to be found among students already at the university, was that of Dr. Grace Leybourne-White during the session 1945–6 [41]. With a sample testing of about 1,000 students out of some 3,000 at Manchester University, the results, when compared with the general population, led to the following conclusions. First, that only 1 in 5 of those of the same age group in the total population whose intelligence is equal to that of the best half of the students (I.Q.124 and over) actually reach the universities; second, that of those equal to the top three-quarters of the students (I.Q.117 or more) only 1 in 8 arrive at the university. The intelligence range (as measured) reached down to an I.Q. of 105, equivalent to 1 in 19 of the population.

Dr. Leybourne-White comments that

> it should not for a moment be imagined that all people of good intelligence necessarily possess all the other qualities which would make them suitable university students. Nor would some of them wish to enter a university even if they could. Their interests might well be less academic. Some of these people are already securing higher vocational training in professional training establishments, in technical colleges, art schools and colleges. Thousands more are training as teachers in colleges outside the present university system. Nevertheless, with so many intelligent individuals outside the university for every one inside it the conclusion is inescapable that, when full allowance had been made along the lines just suggested, the answer must be, no, to the question whether university education in this country is open to all who have the necessary capacity to profit by it [41].

The Committee on Scientific Manpower on the basis of this research concluded 'there is clearly an ample reserve of intelligence in the country to allow both a doubling of the university numbers and at the same time a raising of the standards' [42]. Since then the doubling has taken place, and the question has been raised as to what further expansion is justified in terms of available ability. On these figures the ratio would broadly be 2 to 5 for the top half of ability and 1 to 4 for the top three-quarters, which still leaves ample room despite the raising of standards. This is supported by the more recent figures already quoted in Table 35, p. 227, as these dealt with part of the general population likely to come within this reserve of intelligence. In comparison with university graduates (not undergraduates be it noted) 7% of the Ordinary National Certificate students have intelligence test scores equal or superior to the mean of the university group, and 50% are within the same range as those who have gained a university degree. This is a conservative value, based on first year entrants only, and does not include Grammar School leavers with G.C.E. qualifications who are exempted the first year. For the students in craft courses the corresponding figures are 2·5% and 20%, neither of which is insignificant having regard to the much greater number of these students. To save recapitulation, attention is drawn also to Table 36 in Chapter VII, and that if this were the basis of calculation higher estimates would result than those which follow.

In 1952, about 24,000 candidates sat the O.N.C. examinations (United Kingdom) and these were the residue of a much larger number of first-year students, who are not likely to be very different from those who took the tests described on p. 238. On these very conservative figures, some 12,000 are within the same range of intelligence as university graduates. In the same year 12,575 gained the O.N.C. and these may be taken as a reasonable basis for considering what potential ability there is for transfer to ample courses, full-time or sandwich, which would give them as favourable a chance of passing their examinations as their fellow students at the universities. To these must be added all those in part-time degree courses or taking courses for professional examinations such as A.R.I.C., and the question then becomes rather one of why we should not be much more actively concerned about having at least another 12,000 students in full-time and sandwich courses in major technical colleges.

In 1952 at an F.B.I. Conference on 'The Universities and Industry', Dr. Eric Ashby compared the reserves of intelligence available in the markedly reduced number of young people in the population as shown in Table 44 [43].

TABLE 44

TOP INTELLIGENCE GROUPS AND POTENTIAL UNIVERSITY INTAKE

	1912	1951
Number of boys reaching age of 18	379,700	305,700
Number in top 9% of intelligence range (i.e. intelligent enough to get an honours degree)	34,123	27,513
Number in top 5% of intelligence range (i.e. likely to get a good honours degree)	18,985	15,285
Number entering university	about 4,000	16,537

Dr. Ashby was naturally concerned to argue the question of the supply of potential managers and leaders on the minimum basis of the top 9%, equivalent to an I.Q. of 120 and over, and the reader must follow his detailed argument elsewhere [44]. Here we may note that many who have since discussed his paper in public seem to think that it was only about the universities, and that in future industry would look *alone* to the universities for good ability. But Dr. Ashby is wiser than that for, after expressing his opinion that the difficulties of selection are largely temporary shortcomings, he goes on to say that 'Industry has to foresee a time when the universities *and technical colleges* may have a virtual monopoly of high talent from 18 to 21 years of age' [44] (present author's italics). Certain other points may be emphasised from the technical college standpoint.

No one so far has been foolish enough to assert that invaluable qualities of leadership cannot be exercised by one with an

I.Q. of less than 120, and it is still a matter of open dispute as to what is the lowest level of intelligence compatible with good management, if coupled with a sterling character and attractive personal qualities. While one vice-chancellor may bewail the patient plodders at his university [45], the University Grants Committee puts in a special plea for the pass degree man [46]. Sir David Pye, F.R.S., remarks in this connection

> I deplore the almost pathetic faith shown in the advertisements from all government departments (and some research associations, who should know better) in the first or second-class honours degree. May I suggest that there are jewels to be found, by those who will take the trouble to look, among the supposed refuse of third classes and passes. An ounce of instinct is worth a pound of information [47].

Even if we do not allow for the graduates with I.Qs. of 105 and confine our estimates to the top three-quarters with an I.Q. of 117 plus (16%), the number available increases from 27,513 to about 48,900 as compared with the annual intake into the universities of about 16,500 men into all courses, and of about 3,500 into similar advanced full-time courses in technical colleges. The annual entry to equivalent part-time day technical college courses is about 6,500 per annum. This makes a total annual intake of some 26,500 against a potential of about 48,900, leaving a balance of about 22,400.

Several questions arise to which at present there is no answer; how many of the 16,500 university students should in future go into technological rather than arts courses? How many of the 6,500 technical college part-time students should be transferred or encouraged to enter full-time or sandwich courses? How many of the annual balance of about 22,400 young men, who are not included as students, are likely or can be encouraged to become scientists and technologists, and if so, what would be the repercussions on other professions and occupations, such as medicine, banking and commerce? And if, despite the cumulative effect of all such possible changes, the demands make plain an acute lack of trained ability all round, how far can the intake be justifiably expanded and what is the lowest I.Q. consistent with such advanced training?

Dr. Ashby's figures exclude half the population, and it is no accident that the increasing employment and range of occupations and opportunities open to women coincide with the ever-increasing demands for able trained people. This trend will continue and provokes speculation as to the future education and employment, before marriage and after [48], of the 49,000 women of ability equivalent to the men we have been discussing. The comparative figures are that 19,488 were university women students and 2,308 were in equivalent full-time and 2,332 in part-time day courses in technical colleges, a total of about 24,000, and an approximate annual intake of 5,800. Of the annual balance of 43,200 potential women students many enter lighter occupations for which there is less competition from men, but the introduction of labour saving machinery is altering this traditional balance. Very many scientific occupations and an increasing number of technological ones do not make exacting physical demands, so that we may expect that the reserve of ability in the female population will be increasingly used in such employment, and that a parallel change will take place from the present ratio of four men to every woman attending equivalent university and technical college courses (full-time and part-time). The series of questions raised in the preceding paragraph will apply here also, though probably with differing emphasis.

Even on a conservative estimate there is little to suggest that there is not enough ability available in the population for the development of technological education in the universities and the technical colleges, but there are many problems of recruitment. There is the general social attitude towards industrial occupations, and especially of certain sections of the educational profession, notably the public schools and the grammar schools, through which like attitude breeds like and at best an inertia or indifference towards careers in industry. Professor Hearnshaw's Presidential Address to the British Psychological Society is a stimulating discussion of the importance of beliefs and values in determining attitudes to work [46]. But this situation is changing under the high-powered salesmanship of industry, with intensive and extensive advertisements, conferences and works visits for headmasters and careers masters and, for example, special supplements to *The Times* on 'Careers in Industry' [49]. It is also hoped that pertinent criticism is having a cumulative effect. Out of a multiplicity of excerpts we may note that the *Economist*, in discussing the proportions of students coming forward for arts, science and the technologies says 'It would seem that in the eyes of teachers and parents pure science still enjoys a mystical prestige over applied science. The best administrative arrangements are helpless against this attitude' [50]. Sir Charles Morris at a recent Headmasters' Conference pointed out that the firing of the imagination which determined careers was the work of a teacher, but the question whether a boy was going to be a technologist was put far too late; which is all part of our gentlemanly ideals noted in Chapter I.

While these influences adversely affect recruitment to industry and thus to courses in universities and technical colleges, they and other factors do not operate equally for both kinds of institutions. We cannot here follow the fascinating controversy within the universities about the relative size of faculties and the resistances to change on which the *Economist* makes caustic comment.

> Only a brave man will use the word 'vocational' in academic circles. But it is absurd that the nation should be paying for far more arts students than it needs, and not getting the scientists and the technologists that it needs desperately. To make the science faculties bigger at the expense of arts, would be costly in building and equipment. But it is even more likely to be hampered by the attitudes of the universities themselves, where academic tradition may be stronger than fears about national solvency. As arts students are still by far the largest group in the universities, they could give way quite a bit without really endangering that 'balance' in the universities which is so often pleaded as a reason against any change at all [51].

Whatever the result of this domestic controversy we may note the firm but wise statement made by Sir Hector Hetherington, when he was Chairman of the Vice-Chancellors' Committee, as to the position and development of technology in the universities and technical colleges respectively.

> The plainest issue, though by no means the hardest, is as to technology, on which there is much discussion and some misunderstanding. The universities have long regarded applied science as part of their commission, fruitful to themselves and to the practical business of the nation. Already they have achieved a large, though not disproportionate expansion. They will not be separated from this concern. They are convinced, indeed, that a valuable part of the education of the technologist lies in his association with students of other subjects, and that he, correspondingly, matters to them. But they are not monopolists. They wish to see further experiments and developments in other institutions, especially in the higher technical colleges [52].

Accepting therefore, that there is an urgent need for a great development of technological education, that there is sufficient ability available, and that the universities and higher technical colleges have a complementary part to play [65], we may now consider the post-war proposals which affect the technical colleges most closely.

Post-war Proposals

In addition to the adverse social and educational influences already noted, three other main factors restrict recruitment to technical colleges, especially to full-time and sandwich courses. These are (1) the lack of a reasonable basis of comparison between university institutions and the higher technical colleges which Sir Hector Hetherington mentions; (2) the multiplicity of awards and the great range of courses in technical institutions which has led to a demand for 'a national academic award'; (3) problems of governance, freedom and finance in which the technical colleges stand in sharp contrast to the universities. These three are closely related in origin and cumulative in total effect, but the first two will be considered here and the third, which affects the generality of colleges also, is considered in the next chapter.

All post-war proposals concerning technological education within the technical colleges stem from the Percy Committee Report [4] and its recommendations still contain so much of the heart of the matter as to justify a detailed enumeration, which will also have the advantage of helping us to assess what progress has been made since 1945. Though the Committee confined its attention largely to engineering its main recommendations are of much wider relevance. The order (i) to (xv) is not as in the Report, references to which are put in parenthesis in each paragraph, as also are the chapters in which the matters are discussed in more detail.

i. A strictly limited number of Technical Colleges, designated as Colleges of Technology (§31) should be selected in which there should be developed technological courses of a standard comparable with that of University degree courses (§29).

ii. To meet the needs of small but highly important and specialised industries, a few National Schools of Technology should be established within technical colleges (§§29, 51) (Chapter XIII).

iii. The selected technical colleges 'must be developed into responsible academic institutions, performing a national function' (§30), to which end

a. They should provide for a considerable number of residential students (Chapters XVII and XIX).

b. They should be subject to the ultimate control of the providing local authority in matters of finance and general policy, but each should have its own governing body containing adequate representation of industry, and a Board of Studies, representing its teaching staff, responsible for academic policy; the foregoing to be under a Scheme approved by the Minister to 'give the Colleges the greatest possible degree of self-government and responsibility' (Chapter XVI).

c. The providing authority should receive a substantially higher rate of grant in respect of revenue expenditure on their national as distinct from their local function, and that the National Exchequer should consider giving special assistance also by capital grants, as was then contemplated for the universities (Chapter XVI).

d. The salaries and conditions of service of comparable teaching staffs should be similar to those of university teachers, especially in teaching hours, tutorial duties and research, and superannuation arrangements should be adapted to secure the greatest possible freedom of movement between colleges and universities (Chapter XVIII).

e. They should so far as possible be relieved of elementary teaching duties (Chapter XVIII).

iv. New courses should be established at the post-intermediate stage with a substantial part of the students' working year 'occupied by a planned course of works practice', in addition to substantial periods of full-time study, equal in the aggregate to a full-time degree course (§26) (Sandwich Courses, Chapter III).

v. All students of technology, whether at university or colleges of technology, should be introduced to management subjects during the final years or two years of their undergraduate course (§§70–3) (Chapters III, VIII, XII and XVII).

vi. That research, as a necessary concomitant of all higher teaching, should be developed in the colleges and in conjunction with industry, the Research Associations and the Universities (§50) (Chapters XV, XVIII).

vii. The Committee was unanimous in recommending that any qualifications awarded by the Colleges must be guaranteed as conforming with a national standard, but that this should not be through yet another external examining body (§§53–5) (Chapter XVI).

viii. The Committee could not reach agreement as to the title of technological qualifications to correspond with the university first degree (§56). Paragraphs 57 to 61 give the arguments for a degree, Bachelor of Technology (B.Tech.), paragraphs 62 to 65 discuss the alternative favoured by some of a new State Diploma in Technology (Dip. Tech.).

ix. A second and higher qualification will be needed, comparable to that of the University Ph.D., and should be Doctor of Technology (Tech.D.) (§66).

x. The Chairman, Lord Eustace Percy, differed from the alternative proposals of B.Tech. and Dip. Tech., and in a Note appended to the Report put forward a third recommendation, namely: the selected Colleges should be designated Royal Colleges of Technology, each awarding its own Associateship (A.R.C.T.) and its Fellowship (F.R.C.T.) at the post-graduate stage (pp. 25–7).

xi. Regional Advisory Councils, with appropriate Regional Academic Boards, should be established in England and Wales, and eight regions were tentatively suggested (§§33–40) (Chapter V).

xii. Interchange of students between universities and colleges of technology should be facilitated at the matriculation, intermediate and post-graduate levels (§§46–9).

xiii. The recruitment of students both to the colleges of technology and the universities should be fostered by the continuance of the Special State Bursary system, with improved selection and awards taking account of students transferring from industry and part-time courses to full-time courses (§44) (Chapters XVI, XVII).

xiv. Teachers should return to industry for substantial periods, including experience abroad, and exchanges with teaching staff in institutions abroad should also be made (§§76–8). Refresher courses should be arranged both for teaching staff (§79), and for graduates who have been in industry for some time (§29). Industry should also be prepared to release senior staff to give advanced lectures during the day (§80) (Chapter XVIII).

xv. At least one institution should be selected as a centre for post-graduate study of industrial administration (§74).

Now let us take stock and see what has been done to implement these major recommendations. First of all the clear cases:

ii. Seven National Colleges have been established (Chapter XIII; p. 603).

vi. Research has been fostered by the improved conditions made possible under the Ministry's Circular 94 (issued April, 1946) though much more still needs to be done.

xi. Regional Advisory Councils and Academic Boards have been established, and a National Advisory Council on Education for Industry and Commerce has been established under the Ministry's Circular 87, issued February, 1946 (Chapter V).

xiii. A system of Technical State Scholarships has been established, though this is not working satisfactorily (Chapter XVI).

xiv. Arrangements were made under the Ministry's Admin. Memo. 134 (issued March, 1946) for the easier release of teachers to industry, but Local Authorities have recently been informed of its poor implementation (p. 213).

Refresher Courses have been arranged through the Regional Advisory Councils and in conjunction with the Technical Teachers Training Colleges (p. 537). Post-Graduate Courses have also been arranged for graduates in industry and have recently been recommended to be held on a part-time day and full-time basis under the Ministry's Circular 270.

In addition to these definite achievements certain other steps have been taken, though they do not fully meet the recommendations of the Percy Committee. No colleges have been selected and designated as Colleges of Technology (Royal Colleges of Technology), but the following advantageous steps have been taken:

iii*b*. In April, 1946, the Ministry's Circular 98 was issued concerning the constitution and functions of Governing Bodies of major colleges, but Chapter XVI shows to what little extent it has so far been implemented.

iii*c*. The Ministry's Circular 255, issued in July, 1952, laid down conditions for the recognition of courses in advanced technology for an increased grant of 75% (instead of 60%) and Chapter XVI shows that so far 24 colleges have had courses recognised (p. 607).

iii*d*. As noted above under (vi) teaching hours have eased somewhat in relation to research, but this benefit has been less for overall hours of teaching; salaries were improved under the 1951 Burnham Technical Report, hardly at all under the 1954 Report, and those for senior posts are now far behind the recently revised university salaries (p. 533).

iii*e*. Major colleges are in process of shedding their more elementary work, and this is strongly encouraged by the Ministry's Circular 283 (3rd December, 1954).

iv. Sandwich courses, with full-time study integrated within the overall period of industrial training, are being developed, but not at sufficiently fast a rate, due to the lack of recognised standards and qualifications and of financial grants.

v. A small beginning has been made to introduce management subjects into these full-time and sandwich courses, but this is still a matter of controversy.

xii. A very small transfer of students at these three levels has taken place from the technical colleges to the universities as witness the working of the Technical State Scholarship system (p. 527).

xiv. A very limited part-time day-release of staff from industry takes place for teaching purposes, but far more needs to be done both for technological and management courses, for which really senior staff of high responsibility and wide experience are vital.

xv. In one sense this has been superseded by the establishment of the British Institute of Management, in another by the Administrative Staff College at Henley, and in part by the developments in major colleges and in the universities (Chapter VI). The desirability of a separate post-graduate college, adapting the system of the Imperial Defence College to the study of higher scientific and technological administration [52*a*], as advocated by Lord Hankey is still a matter of debate.

Thus on the positive side we have some definite achievements, some hesitant steps in the right directions, and some clearer indications of the further necessary progress to be made. On the debit side there remain a group of unresolved but highly important problems:

i. The inability or reluctance to designate major colleges of technology.

iii*a*. No real attempt to enable major colleges to provide appropriate and adequate residential accommodation (Chapter XIX).

iii*b*. Problems of governance remain unsolved despite the issue of the Ministry's Circular 98 (April, 1946) (Chapter XVI).

iii*c*. Likewise financial problems remain unsolved, and no move has been made to introduce a system of special assistance by capital grants (Chapter XVI).

(vii), (viii), (ix) and (x), until recently no progress had been made on the critical question of academic awards at first degree and higher levels (see p. 578 concerning recent announcement).

The problems under (i) and (vii) to (x) will here be closely considered, leaving other matters to the chapters shown in each paragraph.

The National Advisory Council on Education for Industry and Commerce [53], established in 1948, published in October, 1950–2, as its first main act, its Report on *The Future Development of Higher Technological Education* after consulting many interested parties [54]. The main points were:

1. The development of new courses of advanced technology in the technical colleges in close association with industry and with the co-operation of the regional academic boards.

2. Consideration by the Minister of Education of the possibility of increased financial aid to the authorities and a more generous allocation of building permits.

3. The establishment of a national body with the title 'Royal College of Technologists'.

4. The Royal College should approve

a. suitable courses of advanced technology submitted by technical colleges under conditions appropriate to first and higher awards.

b. the appointment of suitable external examiners to assist the colleges in setting and marking their own examinations.

5. The Royal College should be a self-governing independent corporate body and that

a. it should consist of a Court (with constitution, etc., as laid down in the Report).

b. the Court should appoint a Council which should include persons nominated by universities, technical colleges, employers, employees in industry, professional institutions and local education authorities.

c. the Court should appoint the Academic Board which should include persons from the teaching staffs of technical colleges and universities, and persons experienced in educational matters chosen from among professional institutions and industry.

6. The first Award should be an Associateship (A.R.C.T.), the second Award should be Membership (M.R.C.T.) with Fellowship (F.R.C.T.), and Honorary Fellowship for those who further distinguish themselves in the field of technological education and research.

After the prolonged discussion referred to, the government eventually issued in September, 1951, a White Paper stating their policy 'for the Development of Higher Technological Education in Great Britain' [55]. The government accepted recommendations 1. and 2. and also the 'granting of awards of associateship, etc., designed in the main to encourage technical college students to take appropriate courses in higher technology.' They also proposed to seek for a Royal Charter, but not at this stage to ask that it should be given the right to use the title 'Royal', and the national body would therefore be designated the College of Technologists. These limited proposals were overtaken by a change of government, and the only positive result for the technical colleges has been the increase in grant for approved courses in advanced technology under Circular 255, issued in July, 1952.

On the academic side, what might be called the years of attrition have followed since 1951. The National Advisory Council, asked by the new Minister of Education to advise her, undertook discussions with the professional institutions whose support was rightly felt to be vital in the success of any new scheme. These discussions proved to be very protracted and during this period two other reports were published, both remarkably similar in character.

The first was the Policy Report of the Association of Technical Institutions adopted in June, 1954 [56], which rejected the idea of a national award of Diploma in Technology (Dip. Tech.) awarded on the basis of approved courses, and recommended that the matter of the award should be left for the collective determination of their proposed Regional Colleges (p. 491).

Then the Memorandum on Higher Technological Education of the Parliamentary and Scientific Committee was published in July, 1954 [57]. This recommended that some technical colleges (perhaps twenty eventually) should be selected and granted a Royal Charter as Royal Chartered Colleges of Technology, which should preferably be financed through a Special Grants Committee analogous to and closely co-operating with the University Grants Committee. Local authorities should participate to a limited degree in the financing of these Royal Chartered Colleges in the various regions. The colleges should have strong governing bodies with adequate representation of industrial, commercial and university interests in the region as well as of local education authorities, the Ministry of Education and the professional institutions. These colleges should provide for advanced full-time, sandwich, part-time day and evening courses, post-graduate courses and research on a full-time and part-time basis. The full-time and sandwich courses at undergraduate level should lead to the award of a Bachelor of Technology (B.Tech.) and research to appropriate higher degrees.

The policy of creating a nationally awarding body is based on the belief that it is a necessary condition for establishing a technological qualification alternative to the university degree. Its chief proponents contend that in no other way will the thraldom of the London University external degree system be broken and a prestige be gained equal to that of a university degree. The award is not meant to be a professional qualification and the national body would not act as an examining body; competition or confusion with the professional institutions would thus be avoided and the colleges after their initial recognition would have real academic autonomy. The argument points an analogy with the universities, in that they attain to full university status only after a period of minor status as a university college taking London University external degrees or, as at Stoke, in awarding degrees under the surveillance of established universities; thus there should also be a period of dependence under the national body for those colleges with recognised courses of study. Finally, it is argued that this would be an evolutionary stage not a revolutionary break with tradition [64], in that it would carry the Joint Committee system for awarding National Certificates and Diplomas a stage further to give much greater academic autonomy to the colleges, but still under some national surveillance.

Diametrically opposed to this view is the idea that academic prestige cannot be conferred by a national body or award, but must be earned by the particular college which is enabled to gain it by appropriate conditions of staffing, equipment and accommodation. The fulcrum of academic advance is in the college not in an external body, in the college having its own autonomous senate, not in some external body which because of its much wider and non-teaching membership, cannot even be an external senate of all the colleges concerned. This view lays primary emphasis on the selection of a strictly limited number of colleges, and not of courses within a much larger number of colleges.

It is arguable that the selection of these colleges would be, in fact, a recognition of the present position, wherein the greatest number of qualifications are gained by students from a small minority of colleges, as shown in Table 45.

TABLE 45

SOME QUALIFICATIONS GAINED BY TECHNICAL COLLEGE STUDENTS

It is greatly to be regretted that no central record is kept of final professional qualifications gained by technical college students, and only a limited indication can therefore be given of the quality of their advanced courses, e.g. the following awards gained in 1952:

(i) No. of London University Degrees (Internal)		591
,, ,, ,, ,, (External)		1,102
	Total	1,693
Other University Degrees		338
Associateship of Royal Institute of Chemistry		179
Higher National Diplomas		250
Higher National Certificates		6,311
(ii) But note:		
Number of Technical Colleges whose students in 1953 gained London University Degrees (Internal and External)		74
Number which gained 25 or more degrees		14
Number with Higher National Diploma and equivalent College Associateship Courses		16
Number with Higher National Certificate Courses (part-time day)		141
Number with 4 or more H.N.C. courses with total of not less than 200 part-time day students		12

A survey of the period 1945–9 shows that in 31 of the larger technical colleges 196 original research papers in technology were published by students or staff, and 218 higher degrees were obtained.

The analysis of the results of the A.R.I.C. examinations (p. 432) fully supports the same contention, e.g. 68 % were gained from 15 colleges out of 70 colleges submitting candidates.

These results reflect a fundamental fact that no longer can a single technological course be satisfactorily established in isolation from others, or on a minimum basis without indeed an adequate equal provision of the ancillary subjects [58].

Thus electrical and mechanical engineering require mathematics, physics and chemistry, and these can scarcely be equal without courses in their own right, and all—technology and sciences alike—require staffing and conditions to permit research and post-graduate courses. If to these are added, for example, production engineering, civil engineering, structural engineering, gas engineering and chemical engineering, the bonds of interdependence are greatly strengthened. In another case the grouping of subjects may well be different, but it is the grouping which is so important. The cumulative recognition of separate courses thus becomes a *de facto* recognition of the college as a whole and, so the argument runs, it had better be such from the start. The contention is that to secure the essentials of 'university-*quality*' conditions in staffing, intermixture of students, practical facilities and general amenities, the provision for these can be developed fully only in a strictly limited number of colleges, and that in any case the resources in staffing and facilities simply do not admit of their dispersal through a large number of colleges.

If this policy of recognising a limited number of colleges were adopted, certain consequences would follow at once. Resources would be concentrated, and the establishing of new courses and research, with the making of capital grants as urged by the Percy Committee would be facilitated. Courses would be more readily established on a comparable basis, and financial awards to students to attend them would thus be more easily determined, both locally and nationally. Subject to a system of external examiners on university lines, the colleges would have every incentive and opportunity to earn highest status for their awards, the nature of which they could well determine in consultation with each other, instead of having to adopt one approved elsewhere.

Many of the courses listed in Table 43 were established in a very different social situation from that of to-day, not least for the underprivileged, and their results have naturally generated much local pride which may now be a barrier to desirable social change [59]. Thus the question is posed 'If we have these recognised regional colleges does it mean that a boy will be denied the opportunity of taking his Dip. Tech. at the local technical college?' In these terms it might also be asked why students cannot take the external London degree in every local technical college, why students are denied this opportunity by London University's insistence on inspection and recognition of colleges for B.Sc.(Eng.) and similarly, by the Royal Institute of Chemistry for A.R.I.C. This plea is a resentful hangover from former days when scholarships and financial aids were scarcely available, and ignores the fundamental conditions now essential for the full development of modern technological courses. This very wide dispersion is no longer justifiable, and it is questionable how long many authorities will persist or be justified in running expensive small courses without additional grant. Nor should it be overlooked that the students attending these small and scattered courses will be denied the essential 'university-*quality*' conditions enumerated above—that is the hidden denial of opportunity to the student which a wide dispersion of resources inevitably entails [67].

In December, 1954, the Government rejected the idea of up-grading technical colleges, but stressed the policy of regional planning. Lord Salisbury stated that 'some thirty colleges have been planned to develop ultimately into advanced regional colleges: . . . the technical colleges are not altogether excluded from this field of higher technology. On the contrary, the Government realise that regional colleges must meet the increasing demands for high level training, both for those actually working in industry and also for others who require special technological courses. For this reason we are only too anxious to improve the facilities as soon as possible' [60].

The prolonged discussions between the National Advisory Council and the representatives of the major professional institutions outlasted the period of office of the then Minister of Education, and were resumed with greater urgency after Sir David Eccles had taken office. It was hoped that the new Minister, still continuing in effect to be a Minister of Works, as in the decisions of Circular 283 [61], which relaxed the frustrating conditions of Circular 245 [62], would soon announce a decision on this thorny problem. On 4th May, 1955, the Minister received a deputation from the Parliamentary and Scientific Committee to discuss the expansion of colleges of technology in the light of its recent memorandum (p. 473). Sir David Eccles took note of what was said, but owing to the impending dissolution, suggested another discussion in June [63]. The decision to proceed with a new National award was announced in July, 1955 (p. 578).

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CHAPTER XVI

FREEDOM AND GOVERNANCE, FINANCE AND ADMINISTRATION

Freedom and Education

Out of the furious ferment of war there came the Education Act of 1944 to shape our educational thought and practice for decades to come. Out of the wider struggle for freedom there came far-reaching changes within the administration of the public system of education. For the first time a Minister of Education was appointed 'whose duty it shall be to promote the education of the people of England and Wales and the progressive development of institutions devoted to that purpose, and to secure the effective execution by local authorities, *under his control and direction*, of the national policy for providing a varied and comprehensive educational service in every area' (author's italics).

The Minister's powers of control and direction are subject to the final authority of Parliament, and so far they have been exercised reasonably with a typically British capacity for compromise and for transmuting our intentions and institutions [1]. Nevertheless, at the very beginning of the Act there stands the dilemma, the perpetual problem of authority and freedom; for, as Professor Lester-Smith remarked, in spite of our inherited mistrust of Government interference, the uneven quality of our educational facilities has led us to accept a strong dose of direction and control in the Education Act of 1944. 'In my opinion', he says, 'the future of freedom in education in this country depends mainly on the wisdom with which these immense powers are exercised, upon whether, in fact, due regard is had at the centre to the value of the individualism and diversity for which our forefathers shed their blood in the seventeenth century' [2]. This change, this concentration and re-orientation of power has occurred not only at the centre of the educational system, for the decrease in the number of local authorities fully responsible for education inevitably resulted in a concentration and increase in their powers also.

It is therefore not surprising that the working out of the Act since 1944 has sharpened this dilemma in education and particularly at the growing points of change. There is the acute problem of educational experiments, of how far they shall be wholesale or controlled, how far they should be local education authority policy and how far they should take account of the wishes of the governors and parents of children at a particular school—as witness the controversy over the L.C.C. Comprehensive School and Eltham Hill School and the Minister's decision thereon [3]. Despite prolonged discussion there is still great concern in some quarters about this freedom of the schools, especially of the grammar schools because of some sorely-felt effects of levelling down and fears of more to come. Apart from its educational dubiety, the absolute age rule for entry for the General Certificate of Education was rightly felt to be a limitation of the freedom of the schools, which was properly amended by placing or rather replacing responsibility on the head teachers, a decision therefore generally welcomed by the educational press [4]. The Hertfordshire experiment of trusting the head teachers to have worthwhile tastes and responsible judgement has been enlightened and encouraging. In describing this experiment Mr. J. H. Newsom has declared that it is intolerable professionally that teachers should be told how they should spend their money; 'if you cannot trust the teacher to spend £50 he or she should not be trusted to teach children'. A further experiment is being tried in which the teachers could buy practically everything in the estimate, including paying for heating, lighting, cleaning, etc. The original experiment has saved £7,000 a year in administration, and thus it questioned in very practical terms the common assumption that centralisation of control and bulk treatment are necessarily less costly and more efficient than a system of devolved responsibilities [5]. In the educational press there has been much valuable discussion of the freedom and responsibilities of governing bodies of schools, varying from counsels of despair because of the lifelessness of 'rubber stamps' to encouraging examples of governing bodies free to be responsible [6].

Freedom and responsibility are but two sides of the same medal, compounded of integrity and standards. In education all four must co-exist and entail each other. It is a truism that an increase of freedom is impossible without increased responsibility, but it is not so readily granted that the achievement of high integrity and standards requires freedom and the opportunity to exercise responsibility. Such conditions are of cardinal importance for the universities, which explains their sensitiveness to dependance on government finance now that they are in effect largely direct-grant institutions [7]. All would agree with Professor R. A. C. Oliver in his first sentence, but how many local authorities face up to the implication of his second sentence when he says 'The universities enjoy freedom and authority because they are felt to exercise their responsibility. People in other educational institutions are not essentially different from people in the universities' [8].

Attention has been drawn to the general sensitiveness in education to-day concerning freedom, governance and administration, partly in order to be able to place the problems of the technical colleges in focus in the contemporary scene, and partly to dispel the suspicion that claims for greater freedom and responsibility are but a brand of egoism peculiar to those engaged in technical education. This cynical ungenerous attitude has unfortunately been assumed by some, who ought to know better, in their opposition to new proposals for the governance of regional colleges of technology. Moreover the freedom sought is not that of 'the wild man who defines it is as freedom to spend public money without restriction', but a delicate balance of freedoms in which academic freedom and responsibility should be the first and not the last consideration.

In a democracy worthy of the name there should always be one unwritten but clearly apprehended rule 'All shall strive to increase freedom'. Acceptance of that rule, with all that has been said above about freedom, responsibility, integrity and standards, need engender no fears of licence and irresponsibility. Full acceptance of that rule means a positive reorientation of thinking about practical problems in this field, as great and as similar a change in attitude as that from curative to preventive medicine. Realistically the rule stresses the need for striving and promises no certain results in this arduous uncertain world; but it is equally realistic to believe that if all or even only a majority of responsible people acted upon the rule many difficult problems would not only be solved but be prevented.

In all the widespread discussions of freedom and authority in education, very little has been said on the problems of technical education. Apart from their appearance as by-products of the seemingly interminable discussions on higher technological education, questions of freedom might hardly appear to vex our institutions at all. Anyone who believes this cannot have met many principals in recent years, for they at least know the cumulative effects of many changes and of administrative controls. It was probably one of their number who in 1951 wrote in cold fury as a correspondent to the *Times Educational Supplement* a critical appraisal of 'The English Technical College' [9]. He thus firmly stated that 'There is, indeed, a real danger that the English Technical College is being crushed beneath the weight of external controls' and proceeded to indict the local education authorities, the Ministry, the Examining Bodies, professional bodies of all kinds and trade organisations, in fact all who must necessarily have to do with the work of the colleges.

The Significance of Circular 98

For our present purpose the essentials of Circular 98 (p. 472), are to be found in two paragraphs. Firstly, paragraph 4, states that all major colleges should have strong governing bodies, particularly in having 'adequate representation of important industrial and commercial interests and the universities, as well as of the Local Education Authorities concerned'. Secondly, paragraph 5, which states 'that Governing Bodies so constituted should be given all reasonable freedom of action in directing the affairs of the College, including the power to incur expenditure within the heads of estimates submitted to and approved by the providing authority. In short, subject to the ultimate control in matters of finance and general policy of the providing authority, the College should enjoy such freedom as will enable the Governing Body to develop its work in such directions as prove desirable and to attract first-class teachers on to the staff.'

Circular 98 applies only to 'major colleges of further education' though these are not closely defined nor have they been listed. But assuming that this could be done, there would still be some questions to be answered [10]. Why should the excellent recommendations of Circular 98 apply only to major colleges? Why should they not be applied to all colleges? or at least to as many as possible? Put in another way, what are the factors limiting such an extended application of the Minister's recommendations? Can it be that the governing bodies—outlined in Chapter V—are not sufficiently to be trusted, in which case the remedy is quite other. Of course, this is never likely to be stated publicly as a reason if only because many if not most of the governing body are members of the L.E.A.; 'those who maintain that the purse-strings must be tightly held at County Hall do not explain what strange alchemy it is that makes men reasonable when they sit on a Committee there but irresponsible when they manage a school' [11]. No less is this relevant for those who serve on college governing bodies, and hardly are these likely to be viable partnerships when they are treated so irresponsibly.

Or again, can the cause be the co-opted members, albeit chosen for their outstanding character and influence? Or can it be the presence of influential responsible representatives of industry and commerce? They may well wish to press on vigorously with advancing the work and well-being of the college, but is it thought they will act irresponsibly? To utter the thought is but to underline the ridiculous. One possible argument is that there are not enough good people to go round, or who can be persuaded to spare the time, the lazy argument which has led to grouping several secondary schools under one governing body (sic.). With only 250 technical institutions, mostly widely dispersed and outside London, and rarely more than two or three so close together as to present any difficulties, can it be contended that there really is a problem here—that is, if the governors know they will not be ciphers, ornamental but without responsible function?

Another possible argument is that the work of the college—actual or potential—is not sufficient to warrant such devolution of responsibility. While this might be doubtfully conceded for a very small institution, it could scarcely be maintained for a college of, say, some 1,500 students, and with well-established day and evening courses. Such colleges, and larger ones, surely have a real degree of corporate entity, the variety of interests and changing problems, the need to attract good staff and to expand (for how many have reached their maximum?)—such colleges surely have claims sufficient to bring them within Circular 98? If this were conceded very many more colleges would enjoy greater freedom than at present; it is difficult to discover any cogent reason why they should not.

Some Aspects of the Present Situation

All these foregoing considerations apply in some measure to the question of whether a college should have a governing body at all, which provokes a close consideration of the present state of things. An enquiry conducted in 1952 about the implementation of Circular 98 showed that, far from enjoying its benefits, there were actually some 50 colleges without properly constituted governing bodies [12]. These included large colleges and some which rank as major colleges even in the light of the Percy Committee's restricted connotation. Further enquiry in 1953–4 has shown that of 198 colleges surveyed, 136 have governing bodies which are, in their strictly limited powers, but sub-committees of sub-committees of the education committees concerned. Of the other 62 which have greater responsibility, some 32 enjoyed the conditions of Circular 98 to the full. Of the 136 there are still many without properly constituted governing bodies.

This was and is deplorable. It is still regrettably necessary to have to argue the benefits of having governing bodies for technical institutions, including art and commerce, and colleges of further education. For better or worse, if a college exists, it has to be governed, whether by the further education committee or some other not specifically identified with it. Nothing can better ensure the corporate entity of a college than an established governing body, and we may note an excellent editorial on 'Sharing Power' in the *Times Educational Supplement* which said, 'It would seem pointless, had the suggestion not been brushed aside, to repeat that Governors of character and intellect can bring immeasurable benefit to a school's self-respect' [11]. By the same token, and within the experience of many principals this is equally true of their colleges; and their effectiveness is enhanced by a significant representation of industry and commerce and the university. Many colleges have approved Articles and Schemes of Government, and the A.T.I. and A.P.T.I. have jointly issued a statement on the 'Principles of Government in Technical Colleges responsible to a Local Education Authority' which sets forth the principles upon which an instrument of government should be framed. The technical details present no difficulty; the problem above all is one of the understanding and will.

In the absence of a properly constituted governing body, and also where in practice it proves but to be a very sub-sub-committee of the education committee, there is all too apt to be a confusion of interest, a submergence of the needs of the college in those with greater numbers clamouring for attention. It makes an easy administrative sum (say), 60 schools plus one college equals 61 institutions, a spurious identification through summation made possible only by shedding diversity of function and variety of interests.

Professor Lester-Smith has wisely emphasised the danger here—'Are we not in danger of getting for education one of those adaptable administrative patterns deemed equally appropriate for river pollution or parks and cemeteries? The danger for education is that it will be based on the opinion of experts who regard education as just one of several local services. . . . It is most desirable that local authorities should continue to administer education; and equally desirable that their frontiers should be defined. Otherwise there will be a gradual worsening of relations between teacher and administrator, and an end to the prospect of forging by good fellowship a synthesis of authority and freedom' [13].

Not the least important aspect of this matter of a college having a governing body is its effect on the position and work of the principal, and through him, inevitably on that of the college. Without a governing body the principal cannot make valid and effective contacts at the council or authority level, and is therefore at a disadvantage compared with the chief officers concerned. The meeting of the governing body, which has a direct and continuing interest in the college, is the proper place for the principal to speak upon the work and to make his recommendations thereon. In the nature of things human, and of the difficulties of determining policy, some differences of opinion are bound to arise occasionally between the principal, the director of education or chief education officer, or the treasurer. No one of them has all the truth all the time, and real differences do arise which cast no reflection upon their mutual respect or efforts at co-operation.

The principal must surely have the right to put his case before a body directly responsible for the college. Moreover, he should be able to place any item he thinks fit upon the agenda for a governors' meeting, and not be expected or required to delete it for some reason which after consultation still appears insufficient to him. For example, his proposal may be alleged to set an awkward educational or administrative precedent; witness the falsely egalitarian cry 'If we do it here we shall have to do it in all the other colleges and' (telling addition!) 'also in the secondary schools'—the administrator's *cri du coeur*, as if equality of opportunity required identity of treatment. Many innovations and advances were awkward precedents when they were first introduced, and surely the only thing to do is to examine each one thoroughly on its merits. Of course a principal would be lacking in wisdom if he did not try to discover such possible difficulties and if he did not consult with the chief officer concerned. He may then decide not to proceed with the item, but that should be his own free decision. In the same way he is wise to consult the treasurer beforehand on the financial implications of any proposal he has to make, but if he believes it to be educationally sound he should still put it forward even though it is alleged to be too costly, or there is no money in the current estimate (supplementaries are not unknown, and there is always the next estimate). Another possible objection is that the proposal is not justified financially at the present time, and herein the existence of a governing body is a true safeguard, for this is a matter of policy on which, *inter alia*, they have been appointed to make judgement, and to act on *their* judgement.

One safeguard for the principal is to have and to exercise the right to present frequent reports, not subject to alteration by anyone, to his governing body on the current work and his proposals for the college. To those who enjoy these essential freedoms, all the foregoing arguments may seem superfluous. The facts are, however, that not all those who have governing bodies have all these freedoms, and that many of those without governing bodies enjoy far less freedom and support.

Some progress has been made,but it is still too slow, and yet it was in *April, 1946*, that Circular 98 was published saying that the Minister was 'satisfied that some steps are *immediately* possible which would assist to raise the status of major colleges and extend their influence in the industrial and commercial field' (present author's italics). All shall *strive* to increase freedom! To paraphrase slightly one more reference; 'The truth is that present ideas about administration need revision. The aim should be to work out between local authorities and their governors something of the same sort of devolution that the Manpower Committee recommended between the Ministry and the Counties, so that in the end the Education Committees would become the trustees of their colleges, controlling them where they must and intervening where they had to, but leaving the colleges largely to themselves' [14]. Which is simply the extension of Circular 98 to as many colleges as possible.

The most common reply to any question of delay in applying Circular 98, as of delay in setting up a governing body, is the riposte 'But what is the urgency? Are things not reasonably satisfactory?' People tend to be better than the systems they have to work, and with good will can transform many an unpromising situation into something quite bearable. It is easy to put a premium on good will, to discount other people's frustrations, to rely on their professional reluctance to complain, but it is a poor basis for educational work. We should not make a virtue of necessity when the means have so long been available to prove it an unnecessary evil.

Joint Education Committees

In Circular 98 the Minister hopes that local education authorities will confer not only with industry but with each other in improving facilities in the colleges but also, by implication in the same paragraph 3, in raising the status of colleges through providing strong governing bodies for the colleges concerned. Most colleges gather their students from beyond their own immediate neighbourhood, and the proportion may be substantial, for the disposition of industry and commerce knows no such constricting boundaries, and this fact is the root cause of regional organisation (Chapter V). The sending authority pays on an agreed basis (agreed unwillingly perhaps), for example, until recently 75%, and now at 87·5% of the net cost per student hour excluding loan and other charges [15] [17]. As numbers rise the irksome permit system is introduced to limit the sending authority's contribution and to ensure the maximum use of its own colleges. This system can scarcely be disinterested, and leads to glaring anomalies of what are alleged to be 'equivalent courses' of those in regional colleges to which the student is thus denied access [16].

If the numbers from any one sending authority become a significant proportion of the whole, its contribution to the upkeep of the college is proportionately large, and this means payment without representation on the governing body. The sending authority may then want to secure such representation, and this may be granted by the receiving authority in a token number of places on the governing body of the college. If the proportion becomes substantial the sending authority may suggest to the other that a governing body be established which is a Joint Education Committee in accordance with the Education Act 1944, Section 6, Schedule 1, Part II, §2–3. This is a continuation of a similar power in Section 4 of the Education Act 1921, under which several such Joint Committees were established, and an increasing number have been added under the 1944 Act.

There is no generally agreed idea as to what proportion of students constitutes a good basis for asking or conceding a proportion of places on a governing body, or for setting up a Joint Education Committee, but some existing examples are given in Table 46.

This form of co-operation has undoubtedly proved very advantageous to the colleges concerned, especially as it seems inherently to require the conditions laid down in Circular 94, which they all enjoy. It may therefore be argued that no other solution need be sought for the governance of major

TABLE 46

ANALYSIS OF TOTAL ENROLMENTS OF STUDENTS IN TECHNICAL COLLEGES GOVERNED BY JOINT EDUCATION COMMITTEES

Session 1952–3

College	Date Established	Joint Education Committee Authority A* No.	%	Authority B No.	%	Students from Other L.E.As. No.	%
Dudley and Staffordshire Technical College	1946*	1,651	32·1	2,821	54·9	664	13·0
Royal Technical College, Salford	1941 (Salford, Lancashire)	1,580	24·8	2,696	42·2	2,105	33·0
Walsall and Staffordshire Technical College	1946	1,540	67	705	30	67	3
North Staffordshire Technical College, Stoke-on-Trent	1946	3,402	60·4	1,922	34·1	312	5·5
Wolverhampton and Staffordshire Technical College	1947	2,152	53·8	1,498	37·5	346	8·7
Dewsbury and Batley Technical and Art College	1949	1,723	58·1	1,211	40·8	31	1·05
Nottingham and District Technical College	1945 (Nottingham, Nottinghamshire, Derbyshire)	2,573	45·8	2,136	35·6	Authority C 469 Other L.E.As. 650	7·8 10·6
Wigan and District Mining and Technical College	1954 (Wigan, Lancashire)	952	30·2	1,983	62·8	222	7·0

colleges. Despite these very real advantages, the following facts should be borne in mind.

The arrangement still requires the system of annual financial estimates, in direct contrast to the system of quinquennial grants to the universities, which all concerned hold to be a necessary condition for higher technological education (as defined on page 452) and research. It is noteworthy, too, that the planning of the Department of Scientific and Industrial Research and grants to the Research Associations have recently been placed on a quinquennial basis. In face of these examples it is extremely doubtful whether, since its nature is the same wherever it is undertaken, higher technology and research will flourish in the technical colleges without a similarly secure long-term basis of planning.

Secondly, as two or more authorities have to approve the Annual Estimate, a longer period for approval must be

* N.B. In each case the city/town is Authority A; the County is Authority B (C). In the case of the colleges with Staffordshire participating the co-operation goes back much further than the date given, but under a somewhat different form, e.g. at Stoke back to 1911, in Dudley to 1935 (p. 53). The establishment of these four Joint Committees with Staffordshire was due to the advocacy of Sir Graham Balfour.

allowed to permit of consultation between the authorities. Similar delays occur with unforeseeable supplementaries for special projects. Moreover, the refusal of any one authority to approve the estimate or, more likely perhaps, its action in cutting the estimates has a cumulative total effect. Of £1,000 net cost of expenditure 60 % is covered by Ministry grant and the remaining £400 is shared by the local education authorities concerned usually on a student hour attendance ratio. If for two authorities the ratio is 2 : 1, then if one Local Education Authority agreed but the other, with the less number of students, refuses to sanction its appropriate expenditure it will, by refusing to provide about £133, deny the college an otherwise agreed expenditure of £867. With three authorities involved the minority effect becomes disproportionately greater, as it does also if—as is likely to be true of a regional college—a substantial proportion of its work ranks for 75 % grant under the Ministry's Circular 255. In either case the proportion may then be £920 lost because of a refusal of £80.

Regional Colleges of Technology

Regional colleges are implicit in the whole idea of regional organisation and the reluctance to recognise this fact, and the colleges as such, in certain quarters is remarkable in view of the general lines of argument of the Ministry's Pamphlet No. 8 (especially paragraphs 206 and 208) which was issued as long ago as 1947. Ample evidence exists to show that they have in fact emerged already (p. 475), the question now is the method of their recognition and then the appropriate modes of governance and finance. Will Circular 98 and the establishment of joint committees with the foregoing advantages and disadvantages suffice to meet their needs?

It was to help in the solution of these problems that Principal J. C. Jones, C.B.E., gave his paper 'The Structure of Higher Technological Education in England and Wales' to the Association of Technical Institutions in February, 1945 [17], which led to the formulation of a new policy approved at the A.T.I.–A.P.T.I. Summer Meeting in June, 1954, which made the following recommendations [18]:

1. A strictly limited number of colleges, of the order of 15 to 20, should be selected and recognised as regional colleges each serving a region rather than the area of a particular local education authority.
2. The regional colleges should be principally concerned with advanced courses above the standard of the Ordinary National

Certificate and General Certificate of Education (Advanced Level), together with post-graduate studies and research.

3. The governing body of a regional college should be representative of the local education authorities, industry and commerce of the region. Advisory committees fully representative of specialist industrial and commercial interests should be appointed.

4. The regional college should be financed from grants based on agreed estimates covering a period of not less than three years. Central government sources should contribute not less than 75% of the grant and the remainder should be provided by the local education authorities. The administration of the grant, when made, should be vested solely in the governing body.

5. The selection of regional colleges and the award to them of central government grants should preferably be undertaken by a regional colleges grants committee or, failing the establishment of such a body, by the Ministry of Education.

6. Students should be admitted to the regional colleges at fees which do not differentiate between places of normal residence within the United Kingdom.

7. A regional college should be in a position to confer its own distinctive award upon successful students. For the reason stated in the body of the Report the award of Dip.Tech. is felt to be inappropriate, but the ultimate decision in the matter of the award should be left for the collective determination of the regional colleges when established.

This policy was approved by the two Associations, and many important points were made in the discussion [19], of which three may be mentioned. First, that the proposal of having technical colleges in receipt of direct grant and not under the local authorities is by no means revolutionary for, as Dr. H. Nisbet pointed out, this is the position with the Scottish Central Institutions [20] (Appendix, p. 606). Their recognised position has undoubtedly contributed to their advancement and success, but the community and cities in which they are situated are no less proud of them, not less than an English city is of its Redbrick University. The second point is that while the proposal meets the objection regarding finance (p. 490) it does not sever the regional colleges wholly from the local education authorities concerned, for they would have the right to appoint the majority of the governors of the colleges. This would be in sharp contrast to the *ad hoc* governing bodies of the national colleges (p. 391) and, more particularly, of the Loughborough College of Technology [21]. The Local Education Authorities would also have the right to approve the estimates in so far as their contribution was concerned, and the governing body could not precept upon them for a block grant. Thirdly, the proposals would end the ludicrous position concerning out-county fees [16]. For example, the following analysis obtains in respect of a student attending a regional institution:

	£	s.	d.
The total cost of education of a student p.a.	125	0	0
Fee paid by the student	28	0	0
Sum to be found by local and central government	97	0	0
	125	0	0
For an approved advanced course Ministry grant	72	15	0
Net cost to the local authority	24	5	0
	97	0	0

As the local education authority of the regional institution has the courses in existence it does not consider that the 'out-county' student will cost it the full £24 5*s*. 0*d*. but approximately 70 % of this, i.e. £15 19*s*. 6*d*. Consequently the sending Local Education Authority pays the least amount and by refusing its permission can dictate completely what shall be done. Extraordinary examples exist of students having to travel to their own local education authority's institution by a journey of at least twice the length it need be and by a route which almost passes the doors of the regional institution.

If, because of the reputation, staffing and facilities of the regional institution, the unfortunate parent still wishes to send his offspring there, he is denied any benefit of the central government grant to which he pays his contribution through his income tax; which is but regional organisation in reverse at the parent's expense. The same local education authority would presumably not hesitate to pay for a similarly qualified student to attend the university, and even the poor parent would not be required to pay more than the university fees which are £80 at most, instead of the £125 which is exacted if he exercises his choice at the technical College without a permit. This discrimination has been exercised as between internal and external courses and permits have also been refused for research. Students with high responsibilities in industry have also to submit to the permit system when wishing to attend post-advanced/post-graduate courses, though not at a university.

This situation was noted in the mildest terms in the Ministry's 1953 Report under the heading *Financial Adjustments between Authorities* (paragraphs 46–9), but the fear is that this will simply perpetuate the permit system, instead of ending it as in recommendation 6, on p. 492 above. The Report states that under Section 7 of the Education Act a local education authority, which provides further education for a student from another area, can claim payment for him provided that the authority from whose area the student comes has agreed to his attendance. The amount of the payment represents either the whole or a fraction of the cost of provision, as may be prescribed by the Minister. The problem is now being discussed by representatives of the Ministry and the L.E.As., and it is hoped that a satisfactory solution will soon be found.

Financial and Administrative Considerations

It requires no great experience of the world and of administration to know that desirable recommendations may be accepted in theory, but do not work out in practice. Enquiry shows that already many different working interpretations have been made of paragraph 5 of Circular 98 relating to governance of the college within the approved heads of estimate. For example, it is found in practice that this freedom is hobbled by limiting expenditure on single items above certain specified amounts, of which £50 and £100 are the most frequent [22]. Even the aided institutions, the polytechnics, are required to have further approval for special items of equipment over £35; surely their high reputation and total expenditure make this a quite superfluous restriction.

If major items of equipment are approved for inclusion in the annual estimate, or in a special loan account, why is it necessary to obtain approval again at the time of ordering, with all the consequent delays? It is not unknown for a governing body to have set up an equipment sub-committee to scrutinise as occasions arise throughout the year each individual item over £10, for this to be done again in the governing body, a process to be repeated in the further education committee, and for no order to be placed till the item has been approved by the education committee and the council. The gentle art of re-distillation could scarcely be refined to greater weariness of spirit. If a limit of expenditure on individual items is required in accordance with the 1948 Act, it is still possible to give this sanction at the time of approval of the items in the annual estimate and there need be no delay in placing the orders subsequently.

If the operation of Circular 98 is not to be severely restricted the number of heads of estimates should be small. For example, the estimates of staff salaries should not be subdivided under two heads for full-time and part-time teachers respectively. The variation in college work, as between day and evening courses, between full-time and part-time day courses with use of part-time staff also, makes such a subdivision meaningless and may provide a quite arbitrary restriction upon the work. In a few colleges the governors have power to make adjustments of expenditure as between heads of estimates provided the overall estimate is not exceeded. There are arguments in favour of this but clearly these adjustments can only be of a minor character; otherwise the whole purpose of having heads of estimates is defeated or, alternatively, the original estimate must have been inaccurately made to allow of a large adjustment without seriously exceeding the total estimate.

There seems little doubt that the work and progress of a college, especially if it is one of many under a large authority and has to go through the additional stage of a divisional executive, can be subject to much delay through petty restrictions. On the problems of divisional administration, Miss E. W. Cohen makes some stringent observations which are equally pertinent to recent developments in county boroughs also.

> Unless there is enlightened discouragement the natural tendency of a separate department is toward empire building in order to enhance its own authority and to assert its autonomy. So the supplies and equipment department, instead of acting as a county shop, supplying the needs of its clients and adopting the attitude that the customer is always right, attempts to lay down regulations and to stipulate what shall and shall not be used. And in order to exercise its authority the more completely, it centralises. In one county no supplies however trivial, might be purchased locally and the Director of Education had to put up a long and stiff fight to get a small contingencies fund for each school. Another county council allowed no local printing, and a local technical school that needed handbills at an estimated cost of £40 received them too late for use [22].

To the story of the handbills can be added many another of which we may choose one, by no means apocryphal, of a principal who placed a requisition through the central office of a large authority for a dozen eggs for incubation purposes, and eventually nine ducks turned up. Even at best there must be very close timing to catch the sequence of committees or, perforce, wait the next turn round. The work of technical colleges is inherently variable and requires appropriately flexible administration, and the shorter the line of administration in placing orders the better. One arrangement frequently insisted upon is that orders shall be placed through the education office for countersignature by the director. With all their manifold responsibilities, such chief officers are unable to and quite rightly do not countersign all such orders personally, so in actual practice the principal's responsibility in technical matters is checked by a clerk. Comment is superfluous.

If the annual estimates are properly prepared and closely scrutinised before approval, there seems little reason to go again through all the business of submission through higher committees or for repeated administrative sanctions. It is often argued that 'this is a formality and nothing has ever been questioned or referred back'. If this be true, why keep an empty formality at the gain only of recurrent delays; if it be true what objection can there be to Circular 98?

Academic Freedom and Responsibility

Academic freedom is a prime condition of learning and scholarship, of critical enquiry and scientific investigation, and its preservation in a world clouded with suspicion and riven with hate is a vital and continuing task of this generation. Put in another way, the essential freedoms are easy to list, difficult to attain; freedom of thought and enquiry, of speech and publication; freedom of syllabus and teaching method; freedom of teaching staff appointments made solely on grounds of academic competence and suitability, not of political respectability or other extraneous conditions. These freedoms must underlie the whole educational system in a democracy. A political test here or there is an encroachment menacing and diminishing the whole, but we have been mercifully almost free of political and loyalty tests.

It might be thought by the unwary that this has little to do with the uncontentious technical and scientific subject matter of technical college courses, but a little reflection should bring two significant points to mind. First, the official or party line is no longer remote from science and technology what with official secrets acts on the one hand, and the baleful example of Lysenko on the other. Secondly, if present trends are clearly discernible and continue, there will be an increase in the proportion of general studies in technical college courses, and a further increase in the proportion of adult education courses in our colleges of further education. Management courses can hardly avoid inquiry 'into the meaning of social and economic ideas, into the checkered history of social and economic dogmas' [24], and the problem of academic freedom could then become an urgent one for the staffs of major colleges too.

The academic autonomy of the technical colleges is mostly in very different case from that of the universities, what with the many external recognitions to be sought for courses, curricula and syllabuses from professional institutions and regional examining unions alike. This may not in fact be so restricting as may appear if there is a real working partnership (Chapter V). Nevertheless there is still the very regrettable lack of representation of technical colleges on some joint committees governing National Certificate and Diploma schemes (p. 155) and there may be a regrettably small representation of the technical colleges on the National Council and its Academic Board (p. 578). No wonder a policy has been formulated for regional colleges mainly to secure a justifiable and substantial increase of academic autonomy and status (p. 492). The heretical and impolitic question may also be asked whether the regional colleges would still remain subject to the attentions of the regional advisory councils and academic boards or whether, like the universities, they would not submit their proposals to them, but only to a national body, analogous to the University Grants Committee.

Affiliation with Universities

One solution frequently put forward for enhancing or recognising the work of major technical colleges is that they should be associated or affiliated in some way with the local university. This is dealt with here because, although if adopted it has considerable administrative repercussions, it is primarily an academic matter—for both institutions. The examples given in Chapter V are partnerships of differing degrees of equality and effectiveness. In addition two other examples may be noted, each arising from their respective origins. Nottingham University College provided technical college courses in its former old buildings, and these were shed as the Nottingham and District Technical College was established, and the process was completed before full university status was achieved in 1948. The original position was similar at Sheffield though the arrangement persisted after the foundation of the University in 1905. The University acted as the agent of the Sheffield Education Committee in providing technical college courses, and these have been progressively shed since the foundation in 1947 of the Sheffield College of Commerce and Technology. But the process is not yet complete though the College now provides a very wide range of technological, professional and commercial courses.

The general picture is one of very varied arrangements and certainly gives no very clear lead as to the positive desirability of such arrangements [25]. Indeed, if anything, the general conclusion would appear rather to be an adverse one. Where the arrangement has succeeded at the Faculty level, the technical college has tended increasingly to become like the university. This is not surprising, for that is where the prestige and authority and thus the future is felt to be. The consequences soon become apparent in differential conditions for the teaching staff, for example in salaries and hours of teaching and facilities for research, and recent years have seen an uneasy see-saw effect operating especially in salaries. A second differential is in the growing and apparently irresistible desire to be relieved of all work felt to be of sub-university standard. And by definition all work which does not easily conform to the general pattern of university degree courses is not simply *non*-university work, but *ipso facto sub*-university work. It is an open secret, and it is certainly understandable, that teaching staff who are used to university students on full-time courses do not enthuse about taking a lot more students on part-time courses, students whose academic progress may be hampered by adverse factors which normally do not affect the university student (p. 119). There is thus a desire, though perhaps an unconscious one, to shed or at least not to expand the more troublesome part-time courses. It is difficult to be free of bias in judging this matter, and still more difficult to escape the charge of special pleading, in trying to assess the position and feelings of the part-time students in this situation; but what is seldom or never discussed at official or national level does not thereby cease to exist. That such part-time students feel they do not belong and do not fare so well is no idle or irresponsible reading of the situation. This has almost certainly been a powerful factor, if somewhat hidden away among the others which, cumulatively, have been the cause of failure, or of the ending of such arrangements by mutual consent.

Basically this question of affiliation with the university rests on the idea that the university is the sole source of ultimate academic authority in whatever kind of study and discipline, including all technologies. There are not lacking those in university circles so arrogant of mind as fondly to believe this, but wisdom is to be found in others not wanting in authority. We have noted Sir Hector Hetherington's statement (p. 467) and to this we may add that of Dr. A. L. Goodhart:

> It would be presumptuous and untrue to suggest that the complete man could only be developed at a university, but for most men capable of acquiring what Cardinal Newman described as 'the philosophical habit of mind' a university training was of inestimable benefit [26].

Lord Percy has spoken very critically on this subject as

> . . . a superstitious veneration of the Universities. We have become the victims of another blanket generalisation; that all professional education can best be given by universities, because the university temper and outlook are something more than professional. There is a good deal of truth in that; but it should not be too lightly assumed either that the non-professional virtues of universities cannot be produced in other institutions, or that universities can be relied on to remain thus virtuous, however much professional teaching is unloaded upon them. . . . Certainly this idolatry of Universities has destroyed a number of professional institutions that I suspect we could ill spare. . . . This suggests a second bad habit of ours. Our way of treating the University as a kind of universal nannie to whom we can confidently entrust all our problems of higher education is immensely reinforced by our tendency to treat a Bachelor's degree as a professional hall-mark [27].

Idolatry or not, the pressure to conform or aspire to the university pattern is immensely strong, and there are many who feel bereft if they cannot lean on their Alma Mater, local or distantly removed. Even if this is not possible it can perhaps be projected into the form of a technological university, though many hold this to be a contradiction in terms, lacking the essential universality of study, and that what is meant is a university institute of technology. Be that as it may, some psychological weaning would promote an adult outlook more in accord with the facts of life [28].

Staff Appointments

The importance of Circular 98 lies not only in its general recommendations, but also in that it was at the time of publication—and regrettably still is—a forward-looking document, and it does not overlook the importance of attracting first-class teachers on to the staff. There is a wide variety of procedures for appointing teaching staff. In very rare cases the selection is made by the principal, in consultation with the head of department, a responsibility and a freedom characteristic of the universities, but which many L.E.A's. will find shocking. If regional colleges become recognised and established, will this not entail and ought it not to secure the selection of teaching staff by the principal and relevant senior teaching staff as a sub-committee of the board of studies in a manner similar to the university senate? Though the appointment may be formally approved subsequently by the governors (as by the university council), the searching examination of the candidates will have been an academic one by their peers or superiors in their own subject. How else is the quality of teaching to be secured for that educational freedom and experiment essential to advanced technological education?

In some colleges the principal appoints laboratory assistants, technicians, clerks, typists, porters, maintenance and cleaning staff, but not the teaching staff which he is best qualified by training and experience to judge. In most colleges the teaching staff are appointed either by the governors or by some appropriate sub-committee. In making comparisons it is all too easy to take the best of one side and the worst of the other, to assume a principal who rarely made a wrong appointment and a committee who rarely made a right one. But, as we all know, and the state of the colleges testify, the system works reasonably well, though some may wonder whether there is not an undue expenditure of man-hours in the process.

Most, but by no means all, of those governing bodies which are essentially sub-sub-committees of education committees, have the power to appoint assistant members of staff, but even here the Burnham Technical Report 1951 brought about some surprising differentiations. In some cases the governors may appoint assistants Grade A and others Grade B as well without further approval, but not lecturers and still less senior lecturers who may even be interviewed and appointed by a joint committee (who may still require further confirmation). All this would be amusing if it did not betray a poor appreciation of the capabilities of governing bodies, the essential conditions of interviewing, and the need to avoid delays. Here, too, the argument that subsequent approval is only a formality makes an appearance, but a poor excuse. In view of the arguments above in respect of regional colleges, it may be thought that both sets of arguments are but special pleading and mutually exclusive; the truth is that the arguments put forward for the regional colleges are the ideal for all, but the regional colleges only are likely to gain them—eventually, the generality of colleges never. In which case selection and appointment by the administrative body most closely concerned is far preferable to that by any other.

Few governing bodies, not many more than the 32 which fully enjoy the conditions of Circular 98, have the responsibility of appointing heads of departments and the principal. While this should certainly be an essential part of major college status there seems good reason for extending the practice at least to some of the large colleges; unless it is still maintained that a body fit to govern a large college is not fit to make major appointments. For the most part, however, the appointment of a head of department is made by a joint committee of the governors and the further education subcommittee. In some cases a longer short list is reduced by interview by the governors to (say) three candidates who are then interviewed by a joint committee. Not infrequently candidates for a principalship have to appear before the governors, and then a series of committees finishing with the education committee.

Inventiveness and proliferation in education administrative procedure flourish almost as greatly as the long words used to describe them; some 'plain words' and equally plain procedures would be a salutary change. We need a new Occam's Razor for Administrators, 'Administrative procedures are not to be multiplied without dire necessity' (p. 424).

Representation of Industry and Commerce

This has been mainly dealt with in Chapter V (p. 130) but there remain two debatable questions. The first is the proportion of such representatives on the governing body—should it be a token representation of, say, two out of 20, or should it be as high as a third or even a half as in one existing case? The point is sometimes made that the proportion should not be so high as to make it likely that the expenditure of public money shall not remain securely in the hands of the elected public representatives. Is this not another fear of freedom, based on an assumption of irresponsibility on the part of specially selected persons who often carry far greater individual responsibility in their own walks of life? Such a governor may be a director of a firm of international reputation with an annual budget of millions of pounds per annum, or of many another at not so high a level but still concerned with annual budgets far beyond that of an average technical college. Are there not safeguards enough with limited terms of office, with required annual approvals of estimate, and could they not be trusted with triennial estimates for major colleges?

The second point is also a fear—one frequently expressed on behalf of the technical colleges by other more purely academic institutions. It is that the representatives of industry and commerce on the governing body and advisory committees will, by virtue of their direct interest and peculiar powers, soon dictate both what shall be taught and how it shall be taught. This fear has been expressed for the schools by Professor K. C. Wheare: 'The employer's point of view has been expressed by Mr. Gradgrind in *Teach Only Facts*; but employers were bound to have a limited interest in education' [29]. In technical education they must naturally feel a much stronger interest and the risks are greater. And so they are unless a viable mutually respecting partnership is formed (Chapter V). The teaching staff have an academic position to maintain, which should not be difficult if their competence and integrity are evident to reasonable judges, but this is part of a general issue of principle in the governance of technical institutions.

Policy and Administration

The prime concern of the governors is, or should be, with matters of policy. Delving frequently into day-to-day administration is not properly their function. The following saying of John Stuart Mill should be written into the articles of government of all academic institutions: 'The proper duty of a representative assembly in regard to matters of administration is to take care that the persons who have to decide them shall be the proper persons.' Assuming the appointment of competent staff, such administration is the responsibility in varying degrees of the principal, heads of departments and the registrar. By the same token, neither should the governors and the advisory committees be directly concerned with the details and the intimate process of teaching which should be the prime concern of the principal and the teaching staff. To supply perpetual reports and permit perpetual visits to classes in progress, is the true parallel of forever pulling a tree up by its roots to see how it is growing. Granted these essential freedoms the staff know they are trusted and the work flourishes. Fortunately for technical education in this country this is widely realised, and breaches of this well-founded confidence are encouragingly rare.

Aspects of Internal Administration

The homely proverb of 'what is sauce for the goose is sauce for the gander' can be inverted with equal truth when we consider some aspects of the internal administration of colleges.

The days of the authoritarian principal or head laying down the law from on high, with no explanation given if anyone dared to ask, have gone, and gone for good in more senses than one. If 'All must strive to increase freedom' the principal must surely lead the way, but with the insistence that as his own increased freedom means increased responsibilities, so too shall those who desire greater freedom not be lacking in a sense of increased responsibility. The greater our immersion in administration, the more remote do the classroom, workshop, studio and laboratory become, and the greater is the temptation to forget that the centre of gravity, the focal point of education is there, not in the administrator's office. His work is creative only in so far as better conditions of work and progress are secured and maintained for the teacher and student together [30]. These thoughts have recently been strengthened by Sir Gilbert Flemming, Permanent Secretary to the Ministry of Education:

> The duty of the administrator who lives with the brute overall figures . . . is not to think that he carries any greater responsibility than a man or woman concerned with teaching a class of children, but to see that his continued facing of tasks measured in terms of this kind does not diminish his power to appreciate the imagination and originality of the man or woman tackling his or her own task in the college or classroom. He must never forget that the purpose of all his labours is to provide scope and opportunity for that imagination and originality [31].

If the principal, through being an administrator, loses this insight and perspective, his way is lost and his true vocation gone.

Plainly the principal, especially of a larger college, must devolve responsibility, and this is carried down through the heads of departments, senior lecturers, and so on. There are many ways of arranging this, depending largely on the size of the college and the range of its work (p. 504). This will clearly influence the degree of responsibility and independence accorded to heads of departments [32]. There must be care that the governors' policy is not frustrated or suffers no undesirable additions, that the principal does not have major decisions made more difficult or impossible, and so forth, but the remedy or rather the prevention of all such is in the relationship between the principal and heads of departments. There must be a clear two-way understanding as to what is and what is not devolved in correspondence, as in other things, so that the heads have the maximum freedom of action within their own departments and in personal contacts with parents, representatives from industry, commerce and so on.

The mode of administration, as shown in Diagram 32, will depend not only on the size and range of work of the college; it will also reflect the principal's outlook and personality. A sharp separation between the academic and day-to-day administration is very desirable. The former is secured by having a board of studies which, in addition to the heads of departments, should have senior teaching staff as members, for example senior lecturers or lecturers. It is essential to have a large proportion of members who are primarily engaged in the teaching of advanced work and not in administration, otherwise even here academic matters may be at the mercy of administrative convenience. The board of studies should be responsible for raising and maintaining academic standards in the college, and not least should watch the academic impact of the regulations and requirements for external degrees and professional examinations. Unless the college board of studies is fully empowered to accept these responsibilities and jealously maintains them, the conception

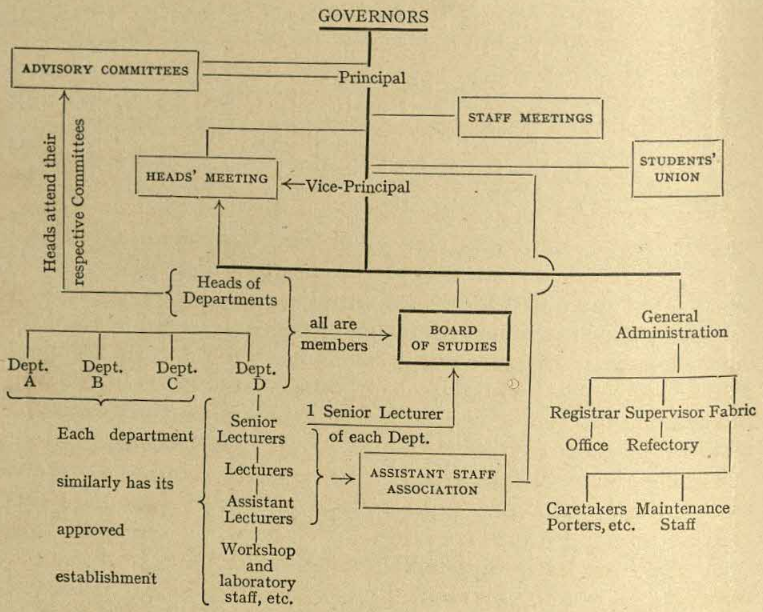

DIAGRAM 32. GENERAL ACADEMIC AND ADMINISTRATIVE ARRANGEMENTS OF COLLEGES

of a regional college as outlined above, can never become a practical reality.

The general administration of the college can be efficiently conducted through a heads' meeting of which the principal acts as chairman. This should meet as often as required, and not merely to solve a crisis; indeed frequent meetings, weekly or fortnightly, will tend to prevent problems reaching a critical stage. The whole intent and atmosphere of such meetings should be to promote the general good, and everyone present must have the liberty to appraise and if need be to criticise severely any proposal made, no matter from what quarter it should come. There is of course nothing new in this, but it is not as widely accepted as it might be, and it requires some skill in the chair. Once it is accepted, and there is a mutual respect which can stand the vigorous statement of a case or point of view without generating petty jealousies, it can bring nothing but good to the work of the college, and the well-being of its students. Because of his special responsibility to the governors, the principal cannot be bound in advance to accept the majority vote of either the board of studies or the heads' meeting. An ultimate conflict of opinion is rare, but when it happens it must give both sides cause to think again and more deeply. In the last resort, however, the final decision must rest with the principal, but if it should result in recommendations to the governors he would be wise to acquaint them with the general background.

The heads' meeting, at which the registrar should be present as required, will be concerned with external relationships as well as internal administration. Not least will be their concern with courses and arrangements for the professional institutions which, incidentally, makes it difficult to understand why the principal should not be the examinations officer for the college—centralisation for its own sake, and the interposition of yet another stage in the line of communication through the education office is not a sufficient reason.

Relationship with Staff and Students

From the point of view of freedom, two aspects of the relationship between the principal and his staff should be mentioned. In any college there is need for occasions for supplying information (about developments, new policies and regulations), and for the discussion of problems and ventilation of possible grievances. Regular staff meetings ought to be held at which staff may express themselves freely, and their value is not seriously diminished by the fact that rarely in a technical college can such a meeting be held when all the staff are free from teaching and other duties to attend. To have one with a large proportion present is invaluable, and not least for its recognition that all present, teaching staff, heads and principal, are corporately concerned in the running of the college. In large colleges certainly, matters affecting teaching staff interests and welfare crop up from time to time, and there is also a welcome interest in social activities, provided they are freely undertaken. For these purposes an assistant staff association may be considered desirable, and a principal would be most unwise to oppose the formation of such an association, but should co-operate with it in furthering the general welfare of the staff and the college. He should, however, be very careful not to be manœuvred into the position of seeming less concerned about staff welfare when, because of his proper responsibilities as principal, he feels it necessary to maintain a different viewpoint on certain problems.

With the usual face-saving familiar phrase 'last but by no means least' we may consider the freedom of students, particularly their freedom to organise and be responsible for their own activities. Of one thing we can be certain, that staff organised, staff regulated not to say staff dominated activities have precious little value and no future. This is more widely accepted than before the war, but some curious features are still to be found in the prospectuses of some colleges; in one case the principal appears as president and all the full-time teaching staff as vice-presidents of the students' union, in another the principal is the warden of the union. In many cases the principal acts as president of the students' union and there is a student chairman of their council or executive committee. Too much of an adverse nature should not be read into the principal's presidential function, especially if it has become an honorary courtesy through the years; but there is perhaps more to be said for recognising the change and for the chief position to be occupied by a student. Now the general attitude is that the students must be given the largest possible measure of freedom, and the liberty and elbow-room even to make mistakes. Without freedom, growth in capacity for responsibility is simply not possible. The influence of such interests and activities on a student's personality and outlook is now widely recognised, and its importance to his future career especially in administration and management lacks no advocates. What are still lacking in too many colleges are the means to foster such interests and activities; the music, committee and conference room, the gymnasia, playing fields and swimming baths seem to have receded far away into an uncertain future to the accompaniment of self-explanatory phrases which have a depressingly familiar ring about them (Chapter XIX).

Selection of Students, Scholarships and Other Financial Awards

The selection of students is an important aspect of academic freedom in which, for reasons given in Chapter VII, the position of the major technical college for many of its students is bound to be different from that of the university. But the position is not greatly different for full-time and sandwich courses and, as with the universities, the whole question is inextricably bound up with that of scholarships and other financial awards. This is of prime importance to the students and is considered in the next chapter.

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CHAPTER XVII

STUDENTS' NEEDS AND PROBLEMS

High among the follies of the modern world has been the persistent confusion of man with machinery, and of mankind's wishes and desires with economic forces under an impressive jargon which could not be better designed to confuse ends with means. It is easier to think habitually in such dehumanised abstractions as 'labour supply' and 'labour turnover', of 'hands' and 'economic man' than to make the imaginative effort continually to understand the personal problems and realities masked by them. This peculiar temptation to mental laziness and imaginative sloth is present at all levels of administration, even in running a college or department in a highly competitive world, in which gross aggregates of students and student hours are *prima facie* more readily appreciated because they are more directly measured than quality of service and results. The growth of a college may be shown in the most impressive upsurging graph, and the claim for upgrading a department, or the counter-argument for not recognising one, may be put entirely in arithmetical terms of size and relative expansion. A college which increases in size from 3,000 t0 6,000 students on roll is commonly supposed to have become twice as strong and therefore twice as good. As already indicated (p. 126), it may in practice be more than twice as weak because it has become so much more impersonal. With a doubling in size the problems do not increase linearly, but at a much greater rate, and perhaps four times the effort in these respects may have to be expended simply to maintain good standards. In this chapter we therefore consider more closely as persons the students for whom our colleges exist, and in the next chapter the staffing and administration required to satisfy their needs and anticipate their problems.

The technical institutions are remarkable in the diversity of their students, and the courses and activities provided to meet their needs and wishes. There is no 'typical' student to represent so great a number and diversity, and we shall need to consider them in broad groups in which, too, there is much variation. Of these the mature adult students are the most straightforward to consider, for in the main they know what they want and are self-reliant enough to see they get it; which begs the vital question of those who never come near our doors at all, or of any other adult education organisation. One factor is complete ignorance of what our institutions and the others offer, but another factor which applies also to the students we have, is that while some or many will go back to study, few indeed will go back to school. Many of those outside think it means just that, and there is no surer method of reducing the attendances and killing the interest of those who come than a school atmosphere; especially as so many of these adults think of school as it was for them many years ago, not as it is now for children in our newest schools. But even if there were a perfect school atmosphere it would be altogether imperfect for adults. Not only must it be different but they must be encouraged to make it their own. While in this material conditions (of rooms, lighting, ventilation, furniture and general amenities), are important, the cardinal condition is a right adult relationship between students and staff.

The married man who comes for a hobby not unconnected with his home, or for a refresher course to give him greater satisfaction with or without greater prospects at work; the housewife who comes for a refresher course in modern cookery or household repairs or, more likely than not, for something which has nothing whatever directly to do with being a housewife or mother but is 'a real bit of relaxation'; those who come for a foreign language because of their wish to travel, and the others who have found an increased need of it in post-war trade; the foremen and the executives concerned to discover the secrets of management; those who have found a new delight in the arts and a desire to do or make something of their own in music, drama, painting, design and the handicrafts; the newly-wed and about-to-be-wed for whom new joys have brought the need for new skills; the parents, and especially the mothers, trying to discover new satisfactions and outlets for their energies now that 'the children are off our hands'; so the description of our adult students could go on almost endlessly.

Few colleges will have all of these, though the majority will have adult students with some of these purposes and aspirations which include the vocational, personal, civic and recreative in a manner quite defying any neat classification. Nevertheless the basis of teaching them is fundamentally the same, that whatever they know, and it may be negligible in the particular subject, they must be respected for what they are, adults with minds and lives of their own, seeking out their own purposes and satisfactions. For them the opinionated dogmatic teacher, set up with his or her own competence and knowledge in contrast to their incompetence ('at their age too') is anathema. A wholly didactic manner or method is unwelcome to adults for whom so many issues are neither black nor white, but are capable of more than one solution which is a matter of personal choice. This explains the popularity of the discussion group and the brains trust, wherein the clash of opinion and conflict of judgement are apparent. At the worst these become a kind of verbal sport, but if they are conducted good naturedly and within the rules, their value is not negligible; at the best they partake of the delights of reasoned cultured conversation which is one of the greatest arts of a civilised people. Some subjects lend themselves to this more than others, but it is a poor adult class in which this art is never present. There are opportunities even in a practical class without it degenerating into a standstill 'gossip shop' that some critics fear will inevitably result. Nothing will more sustain a friendly atmosphere between mutually respecting adults than the growth of conversation in this way, and the class will be looked forward to with an eagerness which will certainly enhance its main purpose.

All this is not to set aside the need for 'straight teaching' just because we are dealing with adults, which would be a sentimental evasion of a job to be done. The exposition required should be clear and stand on its own merits without any extraneous support from the teacher-taught relationship; 'because I say so' are infamous last words in adult education. The 'straight teaching' misses its full purpose if the student does not feel some pleasure, if not a genuine intellectual thrill as the lucid exposition unfolds, at the wide survey of a complex field of study or the intense illumination of some favoured corner of it. The enthusiasm and insight of the teacher will remain with the student long after the particular facts have lapsed from his memory, and this both encourages the teacher but also makes for more exacting demands upon him than any passive trade in facts and inert ideas, against which A. N. Whitehead spoke so strongly: 'Education with inert ideas is not only useless; it is above all things harmful. Except at rare intervals of intellectual ferment, education in the past has been radically infested with inert ideas' [1]. Those who teach adults must be careful not to unload on them much impressive academic lumber which they acquired in a longer, more rigorous academic training. 'Blinding with Science' is all too apt a description of the results of not making the imaginative effort to see how little and what kind of indispensable apparatus the student wants for *his* journey into new regions.

Not many of the journeys need be arduous and most can be pleasant, and must be so if many are to make them.

> It is as important, for practical purposes, that education should be attractive as that it should be good. For, unless it is compulsory, one of the great difficulties is to induce people to take it. This sounds cynical; but there are other good things besides education that men do not spontaneously pursue. A minority will follow knowledge for its own sake; but most people need their pudding sweetened [2].

This is part of the general experience of those engaged in teaching in technical education, and is part of the point made by Sir Richard Livingstone about adult education in particular:

> I do not think we shall succeed in developing adult education unless we make it more social. Even in education man remains a social animal. Consider how often education has burned most brightly at a common hearth, where men gathered together in company to warm their hands at its flames. . . . No doubt the lamp of wisdom can burn in solitary shrines and even in dismal lecture halls. But for many it will not burn brightly, if at all, unless fanned by that social, corporate life which exists in a residential university and which both educates and makes education attractive [3].

Of foreseeable generations, very few will be able to go to residential universities or to residential adult colleges even if they were filled to capacity the year round, and so the majority will be denied that particular kind of life. Fortunately first-class conditions and education are not inseparably linked—or else it would have gone hard with the world at large—and given the right tutor and reasonable conditions much can be achieved. The tutor or teacher is the key, and no time-server, clocking in and clocking out, will do; certainly the adult students will not be deceived that his heart is in his work, and this will be far more discouraging than any adverse physical or social conditions (p. 119). The reader will observe that student and teacher must perforce be discussed together, inseparable as they are as the poles of a magnet.

In our civilisation there is no sharp definitive change into adult manhood and womanhood, even with the token latchkey, or with serious National Service which may take place at different ages from 17½ to 25 years, depending partly on choice and partly on the career and training. This lack is one attributable cause of much uneasiness and uncertainty among young people in western civilisation [4], and it certainly means an uneasy transition period spread over many years. If we turn to consider our younger students who are mostly between 16 and 23 years of age, we find great variety of experience and background.

There are those who left school at 15 to go, largely unprepared, into industry and commerce. This great change may have been most casually made, with parents caring little except for the wages and the firm caring little except that a gap has been filled, but some enthusiast somehow persuades them to attend evening classes. Or the change may have been made reluctantly by the boy or girl because school was enjoyable, and by the parents because they could not afford to keep him on at school, or because there seemed no way of filling the gap between school and the senior courses at the local college. But they took care to get a job with a good firm which enouraged study by day-release and soon made him feel that his feet were on the ladder and there were 'real prospects'. There are those who left the grammar school before 16, having been unwilling scholars and therefore not profiting from its education. Again their employment may have been casually or deliberately chosen, with evening class or part-time day attendance accordingly. To these are added those who left at 16 perhaps with a G.C.E. Ordinary Level Certificate in one or a few subjects, and have been able to exercise some choice of a job and have been encouraged to obtain one with day-release. To those without a G.C.E. Certificate the position is less favourable but not forbidding, as jobs are relatively plentiful and there are still employers prepared to look at people with some education but without paper qualifications; but they may not grant day-release and the students perforce attend evening classes. A much smaller group leave the grammar schools at 17 and 18, going not to a university as they, their teachers and parents may have hoped, but going reluctantly perhaps, into industry and commerce as a seemingly less desirable opportunity.

Those who attend our part-time day courses still are the favoured few, and even for them life is apt to be too uncertain and needlessly difficult unless parents, employers and teachers work severally and together to help them. This is not to dragoon them or to mollycoddle them, for servitude and safety at all costs are far removed from education and from the true adventure of growing up. Unobtrusive effective guidance is good, but to help them find their own way and sense of purpose as soon as possible is best of all. And it will not happen on the same day, in the same week or year for each and every one of them, and the stimulus for one will leave another unmoved. But, over the years, the cumulative effects of these influences are encouraging; some of those with promise fulfil it, though others fade away; many of those formerly written off as useless or written down as of no promise, blossom and flourish most gratifyingly. Many do conscientiously realise their limited talents and we can hardly hope for more.

The wastage in courses (p. 238) may give a depressing picture of weakness of purpose, evasion of difficulties, and poor innate abilities, but this is to draw too grave a picture. The dice is loaded too often and too heavily against the young people, and they and the system should be judged by the best of which they are capable, as in the outstanding county colleges and day-release schemes. When the student completes a definite part, but not the whole of a course, or transfers to another, any talk of wastage is misleading. Where the description is justified, however, wastage is a symptom of a cumulative inadequacy at home, in the firm and at college, as well as in the student.

In addition to these groups of part-time students (Chapter IV) we have those in senior full-time and sandwich courses (Chapter III). Those in *ad hoc* one- and two-year vocational courses as in catering or clothing technology, have a good sense of purpose, clearly defined ends and early prospects of putting their newly acquired knowledge and skills to profitable employment. This, together with being treated as a student in college rather than as a pupil in school, proves most advantageous to their personal development. Their poise and personal effectiveness are often surprisingly developed in consequence. Those who enter the general science or Advanced G.C.E. or equivalent groups preparatory to taking degree or higher diploma courses are a less homogenous group. For some it is a second chance after failure elsewhere, for others it is a new chance in a switched career, and for yet others it is a period of sorting out their own vague aims and wishes, a period of selection through training. They are mostly highly individual cases in a way not true of those in other organised courses, and with particular care from the teachers often prove immensely rewarding. Though they can prove unpredictably disappointing, it will be a bad thing if such 'sorting-courses' vanish from our colleges.

Then there are the full-time students taking the degree and higher diploma courses (p. 84), who closely resemble their fellow students at the universities, though this is less true for those who have transferred from part-time courses. The former group will be more or less able, depending on the power of the particular college to attract the students in competition with the universities; if they tend to be less able, some personal problems will almost certainly accumulate in addition to and especially because of the overall problem of passing the final examination, though this may be offset to some extent by the usually smaller size of class. Those students who have transferred from industry to full-time courses to finish their degree courses are a select group, each with a strong clearly defined purpose governing his days. Though he breathes more freely in the ampler air, he seldom forgets that he is on the last circuit of a long race, and the conscientiousness which has driven him thus far may be redoubled to drive him still faster through more hours of the week. He may therefore need sympathetic understanding from parent and lecturer alike to protect him from himself. The part-time student who transfers into a three or four-year sandwich course is not so pressed, from within or without, and experience shows that if he has the reserves to plumb the increased depth of the first year's study, he will last the remainder of the course with relative ease if not with equanimity.

Looking over this range of students and the courses through which they hope to achieve their ambitions (or that of their parents—or their firms, or all three in fortunate congruence) we notice points and sources of strain which may lead to maladjustments and even to breakdown. An inharmonious home (*sic*); an indifferent firm or a foreman hostile to education; over-ambitious parents and poorly or ill-endowed off-spring; a student with ambitions wholly out of keeping with his abilities or personality; a pleasing persuasive personality with little innate ability; high ability hampered by a dour temperament or a clinging family, or shiftless parents; opportunity denied by being an older member of a large but poor family, or yet again by persistent ill-health—the reader will not need the painful list to be further prolonged.

Humankind is remarkably resilient and the tendency to the norm is reversed only under great duress. Strain is a normal feature of life and of growth, and we should not try to shield our students from it (if we could), or else there will be fear-some shocks later. Absorbing strains, and balancing them, is part of the art of living, and maturity comes at least in part by the practice of that art. Nevertheless the pressure on students has greatly increased with the vast increase in modern scientific and technological knowledge condensed ever more tightly into ever-expanding syllabuses; with the social pressure 'to get on'; with the profound cumulative influence of modern publicity, radio and television, stimulating and reinforcing the general competitive tenor of a power-conscious age, appealing endlessly for higher and higher productivity, and rating human satisfactions only in the possession of more and more goods. Some certificates, diplomas and degrees are gained at too high a price in terms of personality, some are never gained but at much the same price and a searing sense of cumulative failure, partly because the wrong course has been taken, or no appropriate course and certificate was available.

There has been much discussion about strain in university students [5] and a suicide rate in certain residential universities alleged to be beyond the normal in the population at large [6]. One reason for concern is the changed catchment of ability for the universities from the former one which was largely from well-endowed homes; 'the trouble is that we are educating a new kind of pupil in large numbers. He comes from the back streets or the labourer's cottage; there is no library in his home; he has brains but no background' [7]. The trouble has not been great with the technical college students for the contrast has not been comparable. Work, college and home are more likely to be part of a self-consistent whole, and his 'sights' are not raised too high suddenly. There is evidence that a student's level of expectation or aspiration for future employment is generally closely related to that of his parents, especially at the O.N.C. and craft levels, and this accords with the recent valuable survey of *Social Mobility in Britain* [8]. It is also related to his performance [9]. The kind of job may well be different but the social level will not be far removed. Those with artisan fathers may hope to reach the lower middle class, but few at the outset will aspire to the upper middle class. Over the years, with the passing of graded examinations and with increasing competence at work, the student may without undue strain raise his expectations far beyond his original hopes, but this will not be the general pattern. Nevertheless, though Oxbridge may have more difficulties than Redbrick, and these in turn are more than those of Milborough College of Technology, the latter's problems are not negligible, and have been much neglected.

Many if not most of the maladjusted students soon cease to come to the colleges but remain problems nevertheless; in any case, if they were helped in their personal problems they would be more likely to remain and become at least moderately competent students. Of the students who persist, again though comparatively few, some do in fact suffer serious maladjustment, and the number of those with personal problems is large enough to warrant much greater attention. Dr. R. F. L. Logan and Miss E. M. Goldberg investigated a normal sample of 18-year-old youths registering for military service and found that, while they were all remarkably healthy in body, 19 out of the 74 were mentally maladjusted in some respects and 12 were so mentally disturbed as to make psychiatric treatment advisable [10].

The skilled craft students were better than average in this small but highly interesting sample, which points the problem of those who never succeed in gaining any qualifications. In some colleges it is reckoned that about 40% of the engineering day apprentices are able enough to succeed in the Ordinary National Certificate Course or gain a City and Guilds Final Certificate, but that this is beyond the remainder, who have no outstanding ability and are weak in mathematics [11]. They are the 'B' and 'C' streams of the secondary modern school. The point is, however, that they are accepted as craft apprentices in industry and, in the majority of cases, will be accepted as skilled craftsmen at the end of their apprenticeships. 'Where they have been admitted, they have been taken into O.N.C. and City and Guilds courses and have almost as quickly slipped out again' [12]. For the good of the student and the efficiency of industry, it is essential to provide appropriate courses for them with some suitable mode of certification of their work in a course basis rather than on a summary practical examination. The cumulative effect of failure is damaging to the student's willingness to work, and to his general attitude to life.

From the foregoing and from general experience, there would appear to be good grounds first, for a thoroughgoing investigation of the problem, and secondly, for some experiments to be made in the appointment of a psychologist to act as a 'student counsellor' in a few technical colleges with a sufficient volume of full-time and part-time day work to justify it. There is also every reason for having a system of 'tutors', modified to meet technical college conditions. There should be members of staff to whom students could go for advice in personal as well as educational matters. Experience shows that this is much appreciated, for some timely advice can be most important in preventing worry and strain, and in setting the student's future along right lines.

Related to these questions of strain in students is that of the kind of education which they should receive, which is the perennial problem of the degree of specialisation which is reasonable or unavoidable. With it goes the question of what kind of non-specialist or non-vocational education and activities are desirable and feasible. In his *Idea of a University*, Newman asserted that 'The man who has been trained to think on one subject only will never be a good judge even in that one'. Dr. Percy Dunsheath, C.B.E., has paraphrased this to fit the present controversy on higher technological education thus: 'The man who has been trained to think in technology only will never be a good judge of technology', and on this rightly bases the case for the inclusion of ancillary sciences, the humanities, and the means to promote accurate and felicitous expression as well as congenial social intercourse within the whole education of the student [13]. Upon this capacity for judgement, Sir Richard Livingstone bases his definition thus: 'If I had to define an educated man, I think I would say that he is a person who knows what is first-rate in as many fields as possible' [14]. This does not entail the impossible tasks of knowing everything, or of meeting everyone and discussing everything, of seeing all the best films and not missing any of the best things on radio and television, nor of travelling everywhere and reading all the latest books; rather should the students, through some part of at least some of these, and in other ways, acquire first rate standards and the power of critical judgement. How are we to do this for our students because of and despite their training in science and technology, or, more accurately and more modestly, how are we to enable them to achieve this to the best of their innate ability?

This question, which lies at the heart of educational philosophy, has received renewed emphasis in the post-war years in all the controversy about specialisation in the grammar schools and the universities, in the alleged narrowness of university graduates and even more of technical college students, the human problems of management and governance in the industrial pre-atomic age [33]. For this reason the National Institute of Adult Education, the Association of Technical Institutions and of their Principals jointly set up in 1952 a National Committee of Enquiry into the Vocational and Non-Vocational Elements in Further Education [15].* It would be both unwise and improper to anticipate the Committee's Report in any way, but certain points may be briefly noted from the controversy and from existing publications[16].

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* This report, *Liberal Education in a Technical Age*, was published May, 1955: discussed at the Summer Meeting of the A.T.I. in July, 1955, and at Annual Meeting of the National Institute of Adult Education in September, 1955 (details from the Secretaries concerned).

Certain subjects are thought to be necessary or sufficient for salvation. Though they are very varied they may command the passionate allegiance of the scholar, the researching scientist [32] or the earnest educator. Chief among these and commanding the widest support is English, mostly to meet the technical need to be able to write lucid and accurate reports, but extending to urgent exhortations for a thorough acquaintance with literature, poetry and the drama [17]. Written and spoken English are now becoming almost as fashionable as they are important, in the guise of 'Communications in Industry', to develop which the B.A.C.I.E. Communications Institute was established (p. 168). It will be a great pity, not to say a great danger, if everything has to be justified vocationally on these lines, but the student can readily be persuaded that his chances of promotion to a post of responsibility will be greatly influenced by his capacity for lucid and accurate exposition. Even if the student readily accepts the need for English in these terms, the teaching will fail if it is narrowly confined to such specific matters as report writing. Quite insufficient attention is still paid to removing the defects of unclear and uncouth speech (a very different matter from trying to impose a characterless standardised speech), which is still a strong social barrier and aesthetically to be deplored [18]. It is also regrettable, especially for full-time students, if wide reading is not encouraged, and some acquaintance made with 'the Great Books' and some great biographies for their own sake, though again there is undoubted vocational gain, for example, in the better human understanding thus reached by those in charge of other people. Biographies are therefore part of the studies at the Administrative Staff College, Henley-on-Thames.

The study of history is widely recommended, and there are many views on its treatment. 'History is the study of man's slow ascent from savagery to civilisation. We want to make people see history like that, and to almost everybody it becomes an interesting subject' [19]. As most students usually lack the time and may also lack the capacity to undertake full studies of historical development, various compromises are worked out. There is also the dilemma of trying either to cover the whole ground or to dig deep. We may favour a rapid survey as at the Massachusetts Institute of Technology or the choice of a particular epoch, as in Professor

J. B. Conant's book *On Understanding Science*. Another compromise is to narrow the field to the student's particular industry; but a purely historical approach may lack the help that comes from other fields of study.

The study may move over the detailed social studies of different communities, and into case studies such as form part of many management courses. At their worst, social studies are but aggregates of various subjects considered to be useful, cultural or edifying, such as some parts of history taken with geography, and some psychology and pseudo-sociology of a purely descriptive kind. At best they comprise an integrated series of studies designed to make the student aware of their scope, relevance and importance. In no case do they attempt the impossible task of making him a specialist in any of the separate disciplines. In order to focus attention on a practical method, let us consider the following brief outline of a scheme used at the Massachusetts Institute of Technology.

First two years: Three hours lectures and discussions per week; a basic integrated course on 'Man in Society'.

Second two years: A choice of electives from the following broad fields of study; history and government; philosophy and the arts; economics and social science. The following are representative examples of many possible 'electives'; Government and Business in the U.S. Society; International Order; U.S. in World History; Development of Ideas; The Growth of Democratic Thought.

In connection with these and comparable studies at other institutions, e.g. the Carnegie Institute of Technology, we might consider the following questions:

Are they a consequence of defects in pre-college education in the U.S.A. which are alleged to have no parallel here? Do they deal with matters more germane to college than to school, in requiring wider experience and greater maturity? If so, ought not something comparable to be introduced into our senior courses, though in our own English way? Is not the experiment at the University College of North Staffordshire an assertion that this is necessary? There the *studium generale* of the foundation year is followed by a degree course in which the undergraduate is expected to study two principal subjects for three years and three subsidiary subjects for one year each. These five subjects must include some representation of each of the three main groups—the Humanities, the Social Studies and the Experimental Sciences. Would the position regarding our full-time senior courses be met simply by the introduction of management subjects?

Can these studies discover the springs of human action and behaviour, and provoke reflection on some of the immutable questions of values and purpose in transient human existence? Do they help people to learn to think for themselves, and especially about those things that are of ultimate importance for their happiness and that of society?

The cultural value of a subject would seem to reside in its inherent power of generating in the student, under the teacher's influence, a wide concern with human activities and interests, and a warm understanding of human nature. Traditionally it is the non-scientific, non-technological subjects and activities which are pre-eminently cultural, the so-called liberal or humane studies—literature and languages, history, the law, philosophy, politics, and perhaps economics. Each subject has its own techniques, and a severe concentration on them may limit the cultural potential of the subject as a whole. For there is more to all study and education than techniques, indispensable though they are. Perhaps it was this that led A. N. Whitehead to make his oft-quoted protestation that 'The antithesis between a technical and a liberal education is fallacious. There can be no adequate technical education which is not liberal, and no liberal education which is not technical; that is, no education which does not impart both technique and intellectual vision' [20]. The Harvard Committee Report in *General Education in a Free Society*, broadly divides education into general and special education; general education which looks first of all to the student's life as a responsible human being, and special education to his competence in some chosen field of occupation [21]. These two aspects are inseparable and Sir Frederick Handley Page asserts:

> The solution of our educational problems is not to be found in making a false antithesis between these two aspects of education, or between these two needs which education meets. The tendency to give the scientist a little dose of the 'Arts' medicine is the result of confusing the liberal and the illiberal with the humanities and the scientists. The real distinction is to be found *not in subject matter*, but *in method and outlook*, whatever the field.
>
> The challenge to educationalists therefore is to resolve this false antithesis of technical education on the one hand and an out-of-date view of liberal education on the other. A new society and an inceasingly industrial age demand changes in our whole attitude to the content and method of education' [22].

In technical education it is comparatively simple to impart technique, but how is it possible also to impart 'intellectual vision'? Let us choose some examples; is it possible in teaching engineering drawing, or building construction; in the group analysis of the metals as in the teaching of atomic structure; and in the techniques of spinning and weaving as in textile design? Many much more difficult examples could be chosen. Is this merely a philosopher's fine phrase or has it reality in first-year courses (S.1), or in S.3, or yet again only in advanced courses (e.g. A.2)? Can it have any reality at all in part-time courses? Was the savant of Cambridge and Harvard judging all students in terms of his own leisure for study and intellectual capacity? What proportion of our part-time students do we expect to attain to any intellectual vision? And what of the rest? Perhaps A. N. Whitehead may have had these in mind when he went on to say 'In simpler language, education should turn out the pupil with something he knows well and something he can do well. This intimate vision of practice and theory aids both. The intellect does not work best in a vacuum. The stimulation of creative impulse requires, especially in the case of a child, the quick transition to practice. Geometry and mechanics, followed by workshop practice, gain that reality without which mathematics is verbiage' [20]. The practical aspect is also well taken by Sir Richard Livingstone:

> I define an educated man as one who knows what is first rate in as many fields as possible. I like to think that a desire to do something first rate is a fundamental human instinct though I realise that human limitations of intellect, physical strength, education and opportunity prevent most of us accomplishing that desire [14].

For each level of practical skill or work there is an appropriate standard of excellence, which the teacher by example must firmly hold before his students. Exhibitions of work and college open days are valuable in bringing before students (as well as parents, employers and the general public) work of high quality produced mainly by their fellow students. Students in a technical college are likely to be more fortunate than many in a university in this respect, particularly if their college has a school or college of art within it or associated with it.

Many people are agreed—perhaps too many—that the sheer pressure of time in part-time courses makes inevitable the postponement of humanistic subjects until after the completion of the main technical courses. How far should students be encouraged to take courses leading to professional qualifications in management, courses likely to take several years on the top of five to seven years of technological studies? Should not the promising students be released for intensive full-time courses of training, modelled on the Henley Administrative Staff College though of a duration and intensity relevant to the particular level of management concerned? (pp. 188, 373). As technical education is not an end in itself, should not management courses form a bridge from technical to adult education? Why does adult education not reach the same numbers as technical education? Need the ratio be so small as 66,000 to about 500,000 (i.e. after allowing for age differences and the varied interests of the total 2,000,000)? Is it because adult education has been too purely university in type? Should not it first of all be based for the many on their work as argued by Guy Hunter? [23].

In seeking reasons for this apathy towards adult education, Dr. Ernest Green finds one in the preoccupation with vocational training, and 'comes to the conclusion that the nineteenth-century emphasis on education for a job is still the main obsession both of the school and the products of the school'. The groups to which he referred in the question, 'Would the group feel that further education of the instructional type is "an end in itself",' were 'almost unanimous that there was no evidence to indicate that technical and professional training (further education) developed any interest in the humanities and liberal education, and most of them agreed that it was viewed as "an end in itself" '[24]. While some criticism may be levelled at the method of enquiry which was used, nevertheless anyone engaged in technical education should seriously consider this conclusion and determine the truth of it within his own experience. It will not be difficult to discover how weak are the links between technical and adult education in his area, and how few of his students go or are encouraged to go on to adult education.

We may indeed wonder how many of our students do fulfil their education within this next stage, of which Sir Winston Churchill, K.G., has written in memorable terms:

> How many must there be in Britain, after the disturbance of two destructive wars, who thirst in later life to learn about the humanities, the history of their country, the philosophies of the human race, and the arts and letters which sustain and are borne forward by the ever-conquering English language? This ranks in my opinion far above science and technical instruction, which are well sustained and not without their rewards in our present system. The mental and moral outlook of free men studying the past with free minds in order to discern the future demands

the highest measures which our hard pressed finances can sustain. I have no doubt myself that a man or woman earnestly seeking in grown-up life to be guided to wide and suggestive knowledge in its largest and most uplifted sphere will make the best of all pupils in this age of clatter and buzz, of gape and gloat [35].

Full-time students generally spend too many hours in class under the guidance of teachers and too little in private study, for which library and other facilities have been lacking [25]. The proportion of time which should be spent in study and homework has not been fully discussed for them, though it has for part-time students for whom it is acute. Nevertheless before we leave the question of studies we may note a passage from Francis Bacon's essay thereon:

> To spend too much time in studies, is sloth; to use them too much for ornament, is affectation; to make judgment wholly by their rules is the humour of a scholar; they perfect nature, and are perfected by experience—for natural abilities are like natural plants, that need pruning by study; and studies themselves do give further directions too much at large, except they be bounded in by experience. Crafty men contemn studies, simple men admire them, and wise men use them, for they teach not their own use; but that is a wisdom without them, and above them, won by observation. Read not to contradict and confute, nor to believe and take for granted, nor to find talk and discourse, but to weigh and consider.

Out-of-class activities and opportunities are vital to the wider education of students and, while there are some excellent exceptions, the general standards of facilities and amenities still need to be raised. In the best examples the range of activities is every whit as wide as in any university—games, sports, music and drama, dances and socials, all manner of societies in which students intermingle to their mutual enjoyment and wider education. In most colleges there is a Students' Union and the degree of responsibility it carries is a most important influence in developing a lively sense of responsibility in the student. Full-time students in technical colleges with good social and athletic facilities are in no different position from those in Redbrick and as adequate residential facilities seem remote (p. 563), much thought is being given to ways of improving the social education of students. Few technical colleges have large or adequate hostel accommodation, but more have systems of registered lodgings. Residence is of great importance and should be made available at regional colleges [26].

The main problem in the technical college is with the part-time student whose brief weekly contact of crowded teaching time makes it very difficult to achieve worthwhile activities. As Sir Geoffrey Vickers, V.C., has remarked, 'collegiate life tends to be inversely proportional to the mean travelling time of students' [34]. Many of these students are already attached to works clubs, old school associations, youth clubs and churches, so that the need is not so great as the total numbers would suggest. Nevertheless many are not so attached and in any case there should be opportunities for fresh activities on the premises. Each 'day' can be organised as an entity, with its own organisation of class representatives and council, but this is easier with the county college age range than with older students, who resent being organised. They must be free to select their choice from a number of offered activities and also to organise their own. General college activities should be offered on each day in sequence and not confined to a single day a week.

Both in getting these activities under way and in helping students to feel they belong to the college, it is very desirable to hold special occasions such as a college assembly, if need be on each successive day in a week early in the first term [27]. Some few colleges hold a college service (pp. 47, 51) or a founder's day ceremony. Prize givings are held though probably not so frequently as formerly. One reason is the greater size of colleges which makes such occasions either very selective or too onerous. Another reason is the inherent delays on the delivery of certificates from external examining bodies so that, if their arrival is awaited, the lapse of time means that many students have changed their jobs, moved away or gone into H.M. Forces. For medium-sized colleges with a limited catchment area they have good publicity value. In the larger college, departmental occasions may be made for the presentation of special college or national awards.

The impact of National Service is important in that it upsets some students, and they need sympathetic understanding both before and afterwards [28]. As already noted, most day-release students and those in certain approved courses may have their service deferred, and this has been advantageous all round (p. 81).

Finance in the shape of scholarships and grants or wages looms large in the student's mind, and expert advice ought to be available to him on all these. For full-times courses, scholarships and awards or grants are available from the local education authority concerned for a suitably qualified student, and their value is usually determined by the parents' income. At the national level there are technical state scholarships and scholarships for mature students awarded by the Ministry of Education since 1949. The total number of awards is shown in Table 47 [29].

TABLE 47

Scholarships and Other Awards
(England and Wales, 1953)

	Awards Offered and Accepted in 1953	Total Awards Current in 1953–4
State Scholarships (G.C.E.)	2,686	5,622
State Scholarships (Supplementary to holders of University Awards)	1,416	3,825
Technical State Scholarships	119	357
Scholarships for Mature Students	30	87
Total	4,251	9,891
Local Education Authority Awards:		
Major Awards to Universities	9,000	26,361
Minor Awards, Bursaries, etc.	928	4,269
Major Awards to Further Education Establishments	2,767	6,560
Minor Awards	3,622	7,848
Total	16,317	45,038
Grand Total	20,568	54,929

Inspection of Table 47 gives a strong impression of a lack of balance in awards to students at the universities and the technical colleges, especially when it is compared with the numbers of students in comparable full-time courses in Table 48 [30], and remembering that less than a quarter of the Technical State Scholarships were taken up in the technical colleges, the remainder being held in the universities [31].

TABLE 48

Relative Proportion of Students in Comparable Courses on Science and Technology in Universities and Technical Colleges
(England and Wales, 1953–4) [29]

	University Full-time Students	Technical Colleges Full-time	Technical Colleges Part-time Day
Science	14,712	3,236	8,341
Technology	7,886	5,407	18,421
Total	22,598	8,643	26,762
Percentage of total in attendance	26·7%	17·9% (A)	7·2% (A)

Note (A) Percentage taken of respective total (which do not include art) namely, 48,202 full-time and 371,504 part-time day.

This analysis does not include the large number of students taking courses for degrees and final professional qualifications in evening courses in technical colleges.

The position regarding awards to students to attend the technical colleges from the local education authorities has greatly improved in recent years, but there are still anomalies. For example, cases still occur where the award is less to a student attending a degree course at a technical college, as compared with a degree course at a university or university college in flat contradiction of the Ministry's recommendations (Circular 252 and Admin. Memo. 425) [31*a*].* In other cases awards have been refused for research on the grounds that such grants are a national matter. Scholars from grammar schools are not allowed to take up state scholarships in technical colleges, not even internally recognised colleges of London University. Technical State Scholarships cannot be held in Higher National Diploma courses even though these are recognised for the special grant for advanced technology under Circular 255. The value of a Ministry's State scholarship depends on a parental means test, and yet the Ministry circulates details of the National Coal Board Scholarships which draw special attention to their freedom from this restriction.

This last point relates particularly to the urgent necessity of encouraging enrolments in sandwich courses, or students to transfer from part-time to full-time degree and other advanced courses (p. 86). Such students have been earning for some years and may be earning good wages and have prospects of promotion even if they stay as they are. They are understandably loth to become dependent on their parents again, and still more to be the cause of a marked reduction in the family standard of living to which they have been contributing. Moreover, under the parental means test system the student cannot be told in advance what he will get (and may have to sacrifice), and delay and disappointment dash the hopes of students and staff alike. If sandwich courses and transfers to full-time courses, especially for students from the smaller firms, are to increase as they should, this problem of awards must be solved, and preferably by a new technological state award separate from the university orientated Technical State Scholarship. Against this urgent peacetime picture of increasing such training and education, it would be of particular interest to know the annual cost of advanced training in the Services, with residence of course in, for instance, such establishments as the Military College of Science, Shrivenham (p. 542).

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* On 26th April, 1955, the Minister announced welcome revised conditions and rates of award for State Scolarships, and these were published in Admin. Memo. 502 (27th April, 1955). Sir David Eccles also expressed the hope that the local Authorities would adopt the same scales and rate for winners of their awards (Hansard, Col. 788, 26th April, 1955).

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29. Ministry Report, *Education in 1954*, Tables 90 and 98.

30. *ibid.*, Tables 57, 58.
University Grants Committee, 'Returns from Universities and University Colleges, 1953–4' (Cmd. 9,477, H.M.S.O., 1955).

31. D. A. Routh, 'State Scholarships and Other Awards', A.T.I. Paper, February, 1954.

31*a*. All but four of the 146 L.E.As. have adopted wholly or substantially the rates of grant recommended therein; about twelve L.E.As. have income scales which diverge considerably from those in A.M. 425 (Hansard, 7th April, 1953).

32. Professor F. W. Rogers Brambell, 'The Educational Value of Zoology', Universities Quarterly, 1953, 8, 62.

33. Lord Cherwell, F.R.S., 'The Importance of Technology and Fundamental Research to Industry', Messel Memorial Lecture to Society of Chemical Industry, *J. Chem. Industry*, 31st July, 1954.

34. Sir Geoffrey Vickers, V.C., 'The Technical College in the next Decade', Address to the Northern Counties Technical Examinations Council, 27th March, 1954.

35. Sir Winston Churchill, correspondence quoted in Report of Ministry of Education Committee (Chairman, Dr. Eric Ashby), *The Organisation and Finance of Adult Education*, pp. 66–7 (H.M.S.O., 1954).

CHAPTER XVIII

STAFFING AND ADMINISTRATION OF COLLEGES

Of prime importance to the students is the quality of the teaching staff of the college, and of great importance to all concerned is the proper administration of the college so that its educational aims and work are not hampered or frustrated. Certain aspects of internal administration have been dealt with (Chapter XVI), which here we illustrate by means of Diagram 32 which may serve as a general pattern.

Diagram 32 is but one pattern with many variants, and the degree to which is it followed or improved upon will depend on the size and nature of the college work, and local arrangements and history. The diagram would be too complicated if all the cross connections were put in, e.g. that the refectory supervisor may be responsible to the head of domestic and catering department for the catering side of the work, and to the registrar for accounts and related matters; or that the registrar may attend the heads' meeting as required or act as the secretary of the board of studies. The groups represented in oblongs in Diagram 32 are the main collective means of considering and carrying out the work and activities of the college, and maintaining the maximum freedom for all concerned (p. 503). The details of internal college administration cannot be dealt with here, but one major point remains.

The question arises from time to time as to what is a good size for a college, or whether there is an optimum size (p. 509), but there is no simple answer. Rather is the question one of asking, for a given size of college, what is the form of organisation which will best serve its purpose, namely, the education of its students and its service to industry and the community. From time to time and especially in a growing institution, there is need to subject the administrative means to a critical scrutiny to ensure that the college can the better achieve its aims. As our colleges are closely concerned with training for administration and management, it would ill become us not to give much thought to our own internal administrative problems—for the good of the students.

The academic staff, including principal, vice-principal and heads of department are appointed in England and Wales upon salary conditions laid down in the Burnham Technical Report [1]. The Burnham Committee was reconstituted under the 1944 Education Act, and the Main Committee deals with salaries of teachers in primary and secondary schools, the Burnham Technical Committee dealing with further education including technical, art and commercial institutions under the local education authorities, but excluding training colleges and agricultural institutions. The Burnham Technical Committee has 13 members in each of two panels, one representative of the local education authorities, the other of teachers in further education (Appendix, p. 616). The secretary of the authorities' panel is the secretary of the Association of Education Committees, and that of the teachers' panel is the secretary of the Association of Teachers in Technical Institutions. The chairman of the Burnham Committee is appointed by the Minister, and he may be advised by officers of the Ministry.

The Burnham Main Committee meets first in considering a request (by either side but usually the teachers) for a revision of salaries, and on reaching agreement the proposals are submitted to the Minister. After the Main Committee has met the Technical Committee meets and, when it has reached agreement, its proposals are submitted to the Minister through the Main Committee. The Minister may not alter the agreed Report and can only accept or reject it, and so far has always accepted it.* Thereupon the Minister issues an Order requiring the local education authorities to pay salaries in accordance with the provisions of the Burnham Report. Unlike the Whitley Councils, under which the salaries of local government officers are determined, there is no provision in the Burnham Committee procedure for reference to arbitration of disputes between the panels [2]. This has not happened in practice until recently when the authorities' panel of the Technical Committee were authorised by the local authorities to ratify the proposed revision of scales as from April, 1954, whereas the majority of the teachers' panel were required to reject the proposals. As a result no teachers in further education received revised salaries until 1st August, 1954, and until then many were receiving less than colleagues in the schools since the Main Report had been accepted. Out of this unhappy period has understandably come a demand from the teachers for the clarification of Burnham procedure, particularly with regard to this question of arbitration should a dispute again arise.

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* Ministry of Education Admin. Memo. No. 500 (April 22, 1955) gives effect to equal pay increments agreed by the Burnham Committee to equate men's and women's salaries after a seven-year period.

The Burnham Technical Report, 1951, was a marked change from the previous one in the degree of flexibility it offered in the determination of establishments of teaching posts, in regard to the proportion of university, advanced and school standard of work carried out in the institutions. The grades of teaching posts, in increasing seniority, are Assistants Grade A, Assistants Grade B, Lecturers and then Senior Lecturers whose maximum under the 1954 Report is £1,215 p.a. Heads of department salaries range up to £1,665 max. p.a. for a grade V Headship. This should be compared with a university senior lectureship of £1,750 max., or a readership of £1,850 max. It is far behind a professorial salary (£1,900–£2,300, perhaps with additional supplementary allowance [3]), despite the fact that the head may have several hundred students taking degree or equivalent courses (e.g. for A.R.I.C.), together with students on research and many, perhaps over 200 students in post-graduate short courses. This newly increased salary differential is bound to have a serious effect on the future of such senior departments in regional colleges. The 1951 Report named for the first time the post of vice-principal, who may or may not be a head of department, and if not the salary must be approved by the Minister as must also that of the Principal. This belated official recognition of the post of vice-principal is a sign of the fact that colleges are open for 16 sessions a week (morning, afternoon and evenings, Monday to Friday, and Saturday mornings) and no one can reasonably be expected to be there the whole time. Moreover, the external duties required of principals have markedly increased since the war; these include relations with industry and participation in the work of regional, professional and examining bodies important to the college and to the cause of technical education generally. The number of the other posts mentioned and the grading of departments are entirely within the determination of the local authorities under the general guidance of the Report.

In Scotland the scales of salaries are prescribed by the Secretary of State after consultation with a council or other body representative of the education authorities and the teachers employed by them. The representative body at present is the National Joint Council to deal with salaries of teachers in Scotland. In terms of section 79 of the Education (Scotland) Act, 1946, it is the duty of the education authorities to pay to the teachers in their employment salaries in accordance with these scales.

Such scales of salary do not apply to the central institutions, of which there are 13 under the Scottish Education Department (Appendix, p. 606). The agricultural colleges are under the administration of the Department of Agriculture for Scotland. The scales of salaries in these colleges are determined by their respective boards of governors in association with the Scottish Education Department.

Part-time teaching staff make an indispensable contribution to the work of technical institutions, coming as they do from all walks of life, and particularly welcome are those with wide experience and holding positions of responsibility in industry and commerce. With few exceptions the salaries offered do not attract them, for these are usually subject to the full impact of income tax; mostly the teachers come from a genuine interest in the work and often because they are former students of the college. Their salaries are determined solely by the local authorities, though often after consultation with neighbouring authorities. National negotiation of part-time salaries remains remote, but there are good reasons for establishing appropriate means of negotiation between representatives of the authorities and of the teachers on a regional basis.

So much for salaries; now we come to something to which they are or ought to be directly related—the quality of the teacher. Dr. Eric James recently dealt a shrewd blow in the battle for standards by saying he was interested not so much in trained teachers as in educated teachers. The McNair Committee put this challenge in another way for technical teachers when they asserted 'The good technical teacher is no mere technician; he is also an interpreter of the modern world' [4]. If that does not require an educated teacher, nothing does. Arresting though the contrast is, the issues are not quite so simple. Education and training are not mutually exclusive, without inter-relationship; education is seldom achieved or received without training, and training is seldom without educative value. Though the exceptionally educated man may teach exceptionally well (perhaps at no initial expense to his students), most will gain from training and further education related to teaching, provided this too is of good quality.

Apart from teachers of art (p. 312), few full-time teachers in technical colleges in the past had taken a full-time course of training for a teacher's diploma or certificate. Some had come with arts or science degrees from the universities via a department of education, but the greater part had joined the staffs of technical colleges direct from industry or commerce, usually after a spell of part-time teaching in the evenings when they have tried their hand out and got a liking for teaching. Until early 1946 no full-time teacher training was available for men and women with technical qualifications and industrial experience [5]. Then the first training college was established at Bolton, and housed within the technical college, the second in September, 1946, in London at the North Western Polytechnic, now separated as Garnett College, and the third in Huddersfield in January, 1947 [28].

It is impossible for any one college to provide for the very wide range of subjects each of which will require the teaching of special method. With a main core of building, commerce and engineering, the colleges therefore specialise somewhat as shown in Table 49 [6].

TABLE 49

TECHNICAL TEACHER TRAINING COLLEGES

ANALYSIS OF ADMISSIONS ACCORDING TO SUBJECT QUALIFICATIONS

	Total 1946 to 1954 inclusive			Grand Total 1954
	Bolton	London	Huddersfield	inclusive
Bakery and Confectionery	30	—	—	30
Building	260	—	165	425
Catering	—	18	—	18
Commerce	196	256	151	603
Engineering	280	142	167	599
Mining	43	—	—	43
Painting and Decorating	—	21	—	21
Printing	—	35	—	35
Science	30	—	65	95
Tailoring	—	—	6*	6
Textiles	23	—	6*	29
Women's Trades	—	161	—	161
Other	—	99	85	184
TOTAL	862	732	645	2,249

The course is arranged on traditional lines of study combined with teaching practice. The study may include some revision or broadening of the technical subject matter, but is mainly concerned with the teaching process, the teacher and his work, the student's nature and motives and how he learns, and something of the background and philosophy of education. Teaching practice, of about 12 weeks divided into two separate periods, is spent in technical colleges in the region of the college. Dr. Eric James has argued for a much greater proportion of such teaching practice and has also

* Ceased training at Huddersfield in 1950.

used the analogy of clinical experience in speaking of 'walking the schools' [7]. The argument is in fact that for sandwich courses (p. 86), in recognising the very great importance of practice and observation on the job under the guidance of expert practitioners. We may wonder whether this stimulating controversy will radically affect these newer colleges.

A further comparison [5], given in Table 50, shows the first appointments taken up on completion of the course.

TABLE 50

Technical Teacher Training Colleges

First Appointments of Students on Completion of Course

	Total 1945 to 1954 inclusive			Grand Total 1954 inc.	
	Bolton	London	Huddersfield	No.	%
Technical Colleges	500	388	484	1,372	62·6
Secondary Technical Schools	99	76	48	223	10·2
Secondary Grammar Schools	20	192	10	—	—
Secondary Modern Schools	167	—	39	—	—
Day Continuation (and similar) Schools	7	(A)	7	504	22·9
Other Schools	18	—	44	—	—
Failed, withdrawn and/or returned to Industry	36	30	13	79	3·6
Overseas, Colombo Plan	15	—	—	15	0·7
Total	862	686	645	2,193	100

A) Included in Technical Colleges total.

Table 50 thus shows that of the students trained in the technical teacher training colleges about two-thirds take up posts in technical colleges and one-third in schools. This unexpectedly high proportion going into the schools provokes some further consideration of the work of these colleges. They appear to be fulfilling a need in secondary education which has not been met by the two-year teacher training colleges, and it is questionable whether these can meet it in terms of training men and women with that previous industrial experience so desirable for teachers in these particular schools and courses. However, assuming the need to be there, the question still remains as to why so many have gone into schools rather than work in the technical colleges for which they were trained. The reason can hardly be insufficient vacancies for there has been a continuing shortage of teachers for technical work in this period of rapid expansion. It might well be influenced by having to choose between school work and that of a comparable or higher standard under the more arduous conditions of work in a technical college, but still on the same salary scale (Grade A). Technical college work unquestionably is more arduous in that the teachers must cope with so many different groups of part-time day-release students, with full-time students, and with evening classes as an integral part of a normal teaching time-table.

There is no status of 'qualified' teacher in further education, as is required in primary and secondary education. Any absolute requirement of this for all teachers in further education would probably be very strongly resisted, not least because it would certainly cut down the supply of valuable recruits. At the moment there is no likelihood that this will or can possibly happen. The three colleges have turned out 2,193 trained teachers of whom 1,372 have taken up posts in further education out of a total of about 9,985 full-time teachers engaged therein [25]. In addition some university graduates (mainly science and arts) who have taken a teacher's Diploma are appointed each year to technical colleges. But the proportion of trained teachers is still small and indicates a strong need for expansion, especially when it is very probable that the proportion of full-time to part-time teachers is too low. Great opposition was therefore raised to the proposal to close the Bolton Training College in 1954. The dispute was referred by the Minister to the National Advisory Council on the Training and Supply of Teachers, and the final upshot was that the proposal was dropped.*

Teacher training is provided in other ways, some of which are in the experimental stage. Of these, the in-service teacher training courses are an attempt to provide training for full-time teachers recruited direct from industry and commerce after they have been teaching for about two years. They thus have ample background of experience for the course, which should increase its effectiveness greatly. Under this system, first introduced in Manchester and District [8] and then in Nottingham [9], the teachers attend the course one day per week for three terms, with pay and, if need be, travelling expenses. The courses comprise general and special teaching methods, together with a brief treatment of such general topics as educational psychology and history, more especially the organisation of technical education. As experiments they have had their difficulties, especially in dealing with too wide a group of special subjects. These will be reduced by further consultation between the staffs of the training colleges and the principals concerned, and by rotation of subjects over the years so as not to offer too wide a choice in any one year. Such courses are best run on a regional basis, with great advantage in the intermixture of teachers from many colleges. Staffing will depend on the resources of the region and may include staff of the technical teacher training colleges, university departments of education, H.M. Inspectors, directors of education, principals of technical colleges and a panel of highly competent teachers in the different subjects from the various colleges. These courses will probably be increasingly linked with the recently introduced City and Guilds Technical Teachers Certificate, which is being established mainly for part-time teachers. The scheme will probably facilitate the transfer of part-time teachers to full-time staff, and some see in it a threat to the work of the three training colleges, even though the Certificate does not convey qualified status or carry a salary increment. The course of instruction must be approved and comprise at least 150 hours of instruction and teaching practice under supervision (p. 152).

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* In May, 1955, the Ministry sent a letter to Local Education Authorities stating that, because of expansion and especially with the increased building programme under Circular 283, a further 2,700 teachers are likely to be required in technical colleges during 1958-9. To meet these requirements the three colleges hope to increase their annual output to about 350 teachers per annum.

These in-service courses are much more practicable, if more limited, than two other proposals which have so far come to nothing. The McNair Committee Report [10] suggested secondment to the training colleges full-time for a month or six weeks at recurrent intervals over a period of two years, and the second was the Ministry's proposals of one term full-time at the training college [11].

These in-service teacher courses are a logical development of the much longer established evening courses for part-time teachers [12]. As most of the would-be 'student-teachers' are working full-time in industry or commerce and have many responsibilities the courses are necessarily short and restricted in scope, but have nevertheless proved to be valuable. One present pattern is a course of eight weekly two-hour meetings on general method and four on special method. The special method may be advantageously taken as a one-day school on a Saturday, comprising demonstrations by selected teaching staff, with discussion to follow on methods and techniques of teaching, rather than on the content of the subject taught. Certain of the larger authorities arrange short courses or conferences, including some on a week-end residential basis, for their teachers, both full-time and part-time. A positive value in these is the heightened sense of belonging to the profession and working together in a good cause.

Short courses are offered by the Ministry of Education, usually at the end of the summer term, with residence in such attractive surroundings as the ancient universities. Though there has been some falling off [13], these courses are very well supported, which is both a testimony to their quality and to the enthusiasm of the teaching staff. They are organised by H.M. Inspectors who year by year gather interesting and competent lecturers to deal with various aspects of the particular subject of the course, be it bakery or building, catering or chemistry, engineering or English subjects. The amount of thought, time and planning required for a successful course is seldom realised even by those who attend, but there is no doubt that these courses have made an invaluable contribution to the quality of teaching in technical education. In view of certain misleading notions abroad about the relationship between the state and education in this country, it should perhaps be emphasised that these courses are not occasions for the heavy handout of inspired Ministerial policy, and of instructions for teaching method and content in the ensuing year [29]. Far from it, they are occasions of free, stimulating discussion and interchange of views and teaching experience, as free of governmental thought control as are the universities and the University Grants Committee.

Since the war there has been the important development of exchanges of teachers in schools with those of foreign countries, more markedly with those of the United States. There have also been many similar visits of university staff abroad, but regrettably there has been nothing comparable with those of technical institutions. Perhaps the most effective cause has been the fact that the British technical institution has no analogue abroad and in the U.S.A., for example, is apt to be taken for a vocational school, though a major college approximates much more closely to many an American urban university [14]. Inter-change between dissimilar institutions or those felt to be very dissimilar, is difficult to arrange, especially when they have deep roots in industry and the staff concerned also act as industrial consultants, with connections which could scarcely be maintained by visiting staff. Nevertheless, much greater effort should be made to surmount these difficulties, for such service abroad can be profoundly stimulating.

Scarcely less remote and certainly no less desirable is the practice of sabbatical leave for staff to go abroad for study and research. Under the auspices of the Anglo-American Productivity Council many a visiting group or 'working-party' has been to the U.S.A., and has contained a representative of the technical colleges. Valuable as the experience gained has been, as must have been evident to the governing bodies concerned, it is nevertheless subject to severe inherent restrictions; there is even greater need and desirability for single visits, which are relatively unorganised and far more flexible in response to fruitful personal contacts with other teachers, scholars and research workers, This idea of returning to or adding to the sources of experience, if not of inspiration, is the reason for facilitating the return of staff to industry, but this also has so far not been successful (p. 213).

Directly related to the quality of teaching is what might be called the literature of technical education. First and foremost is the scientific and technical literature in the journals of learned societies and professional institutions and societies, the many publications of leading industrial firms—in short, an ample range of publications, both permanent and ephemeral, likely to contain essential information and stimulating ideas, such as ought to be readily accessible in a college library. Secondly, not far behind in importance but far below in supply and achievement, is the literature of the theory and practice of teaching in technical institutions. Until the post-war period there was nothing of consequence, for the teacher training colleges and the university departments of education were not related to nor interested in technical education, including the junior technical schools (pp. 94, 536). The setting up in 1946–7 of the three training colleges for technical teachers resulted in a new journal, the *Vocational Aspect* first published in 1948, which has justified itself as a means of getting news and views and the results of investigation and experiment in technical education [15]. Its value, as shown by the many references in these pages, should continue to increase, and all technical teachers should be familiar with it and competent ones, with interesting ideas and experiments, should be ready to contribute to it. Though its function is different, it has in part made good the regrettable demise of the journal *Further Education*, which is also being offset by the attention now being given to technical education by the *Journal of Education*, and the 'Technical Education' supplements in *Education*. We may also note the *Handbook for Part-time Teachers*, published by the Yorkshire Council of Further Education [16]. Of a different kind but also valuable are the *Bulletins of Engineering Laboratory Practice*, published by the Manchester College of Technology. The first issue, in electrical engineering, was produced in 1948, 'to improve an important part of the teaching in colleges and universities'. These elaborate in a detailed way the *Notes for Guidance* and *Suggestions for Experiments*, published by professional institutions in connection with National Certificate schemes, and form the beginnings of what has long been needed, the analogue of *The School Science Review*, for technical institutions.

Quality of teaching is supremely important but, because of its effects, questions of quantity certainly cannot be neglected. The first question is that of determining what are reasonable teaching hours, 'contact' teaching hours as they are often called, in relation to the grade of work and other responsibilities which the teacher may have, including research or administration, as for a head of department. Nothing is laid down and published by the Ministry as to what are minimum or maximum contact teaching hours for full-time teaching service (see below) and this is a matter for the local authorities, who collectively have wisely never published any figures. Quite apart from the extreme difficulty of laying down rigid rules in so complex a system as technical education, there would be the unfortunate human tendency for some authorities to regard the maximum figure as minimum requirements, and some teachers in an unprofessional manner to regard minimum figures as maximum commitments. No figures will therefore be given here, despite the frustrated feelings of these two minorities, for the good and sufficient reason that the arrangements should be subject to reasonable discussion in the light of all the particular issues involved. Three further points must nevertheless be made.

The first is that experience generally shows that contact teaching hours tend to be too high, rather than too low, thus adversely affecting the quality of the work, and this may be because the local authorities or the governors are not sufficiently aware of the inseparable preparation, marking and other duties involved. There are not lacking disingenuous people who persistently ignore such duties in comparing a teacher's hours with a working week in industry. The second is the case of the teacher with a full teaching timetable who takes on evening work on extra pay, perhaps four to six hours a week, and whose teaching suffers from persistent overtime. When a teacher is recruited direct from industry, he may have to face a drop in salary unless he takes on extra teaching until by annual increments the gap is made good. The danger then is that he comes to have a vested interest in overtime. In any case it is unfortunate that a teacher taking up a new appointment which taxes his time and energies should need to do such extra work, and further, that the general level of salaries should make it very difficult to stop persistent overtime.

The third point is to note the Ministry's important Circular 94, *Research in Technical Colleges* (issued 8th April, 1946), wherein the needs of research are balanced against the need to ensure that sufficient teaching service is rendered to constitute full-time teaching service for superannuation purposes. 'The minimum number of hours which may in general be regarded as constituting full-time teaching service is 1,080 a year, of which three-fifths must be devoted to "actual teaching". "Actual teaching" includes duties connected with teaching such as organisation, preparation and marking of papers. Where research work involves the actual instruction of students it may properly be included under the heading "actual teaching". . . . Other research work which is related to teaching will fall within the remaining two-fifths of the minimum time required.' It is also possible for the teacher to devote the whole of his time within the college for a limited period to a particular piece of research provided that the work is related to his services as a teacher. This interrelatedness is very important in its two-way effect [26]. This Circular has provided a valuable stimulus to research in technical colleges, but even so insufficient advantage has yet been taken of its progressive recommendations.

Mention of staffing in relation to research invites comparison with the universities in the matter of staffing ratios. Their overall staff/student ratio (which obscures much variation) rose from 1 : 10 in 1938–9 to 1 : 8 in 1951–2 [17], and to about 1 : 7·5 in 1952–3 [18]. This ratio compares very unfavourably with that of the Royal Military College of Science, Shrivenham, with 398 students and 73 comparable teaching staff, i.e. 1 : 5·5 (excluding demonstrators and scientific assistants [19]. If a great deal of research is undertaken the cost per student place which may be largely determined by the staffing, should be compared not with the average cost in schools or colleges but with the much higher cost of maintaining a graduate on research in industry. This matter will become increasingly important as Circular 94 is implemented in the major colleges.

The staffing ratio of a college is largely influenced by the nature of its work, and it is complicated by the fact that there is a large volume of part-time work staffed by visiting part-time staff. What with this general factor and that a college at present may have work ranging in standard from first year Ordinary National Certificate to post-graduate courses and research, and that colleges vary so greatly, valid comparisons are extremely difficult to obtain. Nevertheless it is very doubtful if the major colleges compare at all closely with the universities in the staff/student ratio for comparable courses; a ratio of 1 : 15 at best is probably nearer the mark.

The Minister of Education keeps check on the quality of technical as of other branches of public education by means of general inspections conducted by H.M. Inspectors. A panel of inspectors, including specialists for the various subjects taught in the institution, is appointed, and is first of all supplied on request with data of the history and evolution of the work of the college; its present work, trends, enrolments in courses and catchment area of students; governance, staffing, examination results and so forth. Then the panel becomes immersed in a critical appraisal of the work of the college during a period depending on the size, nature and complexity of the college and its work, but is usually one week. The main conclusions of a draft report are discussed first with the principal and then presented orally to the governing body of the college, and finally a written report is approved by the Minister. The printed report may not be published without the permission of the local authority and the Minister. Two views may be held about such general inspections; that they are a regrettable necessity as a proper check on the expenditure of public money, and that they constitute a welcome opportunity for members of a profession to give an account of their stewardship.

Many if not most teachers in technical institutions have a very wide range of students in age, background and general interests, in their classes each year and over the years. They need therefore to be not only competent specialists, but also to have wide interests and generous sympathies. They should be interested, as all teachers should be, in their students as persons and be genuinely concerned to help them. If their teaching is 'just a job' with no sense of vocation, it carries its own condemnation, but with penalties for the unfortunate students. They will need special sympathy with the student working under difficulties at home or at work, and with the difficulties of the part-time student arising from courses with syllabuses overloaded by the rapid advances of science and technology. They will try to take account of these by a recurrent revision of lectures and practical experiments, and should not merit the scorn of the student who spoke of 'the veteran teacher with veteran notes'.

Each class and student will require particular consideration, which is the argument against overloaded timetables and too large classes, especially if they are seen for only an hour or two a week. Care will be taken to use the most appropriate methods, including visual aids, while being slavish to none. Duplicated notes may be supplied where reasonable (requiring secretarial assistance accordingly), but the student should also be trained to take his own notes—not immediately on starting but over a longish period as it is a difficult art to learn—so that he becomes less and less dependent on dictated or written blackboard notes. This question of notes looms large in part-time students' minds, as does the question of homework which must also be reasonably handled. Its purpose, as that of note-taking, indeed the aim of all teaching, should be to enable the student increasingly to think for himself: his notes should be a very personal record of his development [27]. This, the most difficult part of the art of teaching, is doubly so in the highly compressed, overstressed part-time course, but, with care and imagination, it can be done as the records and careers of students show. The same considerations apply also to reading and to the difficult matter of textbooks, especially in these days of greatly increased prices; but somehow a start must be made in stimulating intelligent and selective reading.

The ultimate repository and safeguard of the quality of work is the teaching staff of the college, no matter what the checks and assistance provided by inspections, external examinations, advisory committees, conferences, short courses and the like. Education is the product of a personal relationship between the teacher and student in classroom or studio, workshop or laboratory, in seminar or on a planned works excursion or period of field work. If the teacher commands respect because of his evident competence in his subject; if he elicits attention by his own enthusiasm and supports it with interesting and effective methods of teaching; if he has a lively concern for standards and a sympathetic regard for his students, if he meets such an exacting specification all will indeed be well in his work and, cumulatively, in that of the college. As these pages show, he will have much to challenge him and not a little sometimes to perplex and irritate, if not to annoy him intensely. But much will be rewarding as he or she enables the young students to become competent, to find their way in the world, to give them standards to judge and live by; and the older students to satisfy new desires or pent-up ambitions, to make a new start and acquire an added competence either in leisure interests or in work. The balance sheet cannot be struck, for all teaching is an act of faith; much is caught not taught, and the seeds sown often come late and unpredictably to full growth.

Quite apart from the questions of freedom and responsibility in the appointment of teaching staff, the mere mechanics of selection can affect the quality both of candidates coming to interview and of their reactions to it. Courtesy and efficiency are inextricably mixed together, for no process of staff selection can be efficient which adds to the strain of a delicate situation, still less if good candidates are put off by the whole affair. In this situation, as in other ways, the college gets the staff it deserves. Care and critical scrutiny should therefore be given to design of application forms, requirements of references, and to the conditions of interviewing which can enable the best available candidate to be selected [20]. But when all is done from this side, the candidate can do a great deal more for himself than he often does. This applies both to the applicants from the training colleges and to those direct from industry, and the technique of succeeding in an interview is no more to be despised than that of passing an examination. Neither students nor candidates for posts seem sufficiently apprised of this, and a sense of vocation should not be at the hazard of an indifferent presentation [21].

The educational influence of a college can be greatly assisted or hampered by its general administration, and the adequate provision or otherwise of office assistance and machine aids, and of laboratory, workshop and maintenance staff. Most of the essential conditions set down in Dr. W. A. Richardson's pre-war book [22], remain unchanged, though the rapid rise in the work of the technical colleges, both in quantity and quality, have laid much greater emphasis on some of them.

Dr. W. A. Richardson tried to find a simple formula based on the number of students or students hours but, even when restricting his sample to medium and large-sized colleges he found the ratio varied from one clerk per 200 students to one clerk per 1,100 students. Post-war developments, requiring much more clerical work proportionately than in pre-war days (e.g. reports to firms, and official schemes of recognition of courses), brought renewed attention to this problem. This led to a paper by Mr. G. Mavor on 'Administrative Staffing in Technical Colleges' [23]. From statistics supplied by the colleges a formula was devised based on the number of students in various categories according to secretarial requirements. For example a heavier weighting was given to the numbers in courses, such as National Certificates, requiring external assessment and submission of records, or again of reports to firms. The formula was tried on a large sample of colleges and the following general conclusions were drawn from the replies:

a. It is impossible rigidly to apply a formula to conditions which introduce so many variables.

b. It seems to be clear that the majority of technical colleges in the country are inadequately staffed on the administrative and clerical sides. This means that clerical work is being carried out by highly paid (at least in comparison with the salaries of clerical assistants) Principals, Heads of Departments and teachers holding special responsibility posts, to the detriment of further education in the country.

c. Members of the administrative and clerical staff are often employed on evening duties and have little prospects of promotion, with the result that the service is not attracting the best types in the smaller or even medium-sized colleges [24].

The increase in the range and quality of work since 1949 will not ease conclusion (*a*), and it has stressed conclusions (*b*) and (*c*). Conclusion (*b*) has become particularly emphasised for colleges undertaking research and having courses recognised under Circular 255 for increased grant for advanced technology. All medium-sized and larger colleges should have a registrar responsible to the principal for the office and general administration, so as to free the principal more readily for his educational work, including his external duties. The staffing should be adequate to meet periodic peak demands inherent in college work such as the enrolment period, examinations and submission of results for assessment and sending of reports to employers. Understaffing leads to delays, which can harm the students and the reputation of the college quite disproportionately to any small savings which may be achieved.

The technical institutions are, despite what is fondly thought by some engaged in adult education, voluntary institutions; and this because of the voluntary attendance of a great part of the students and also because of the voluntary act of firms in allowing day-release for their employees. Good publicity and external relationships generally are thus vital and an essential part of the general administration of the college.

Publicity is secured in four main ways; by a college prospectus and leaflets for special courses; press advertisements;

the holding of conferences; and by such special occasions as college open days. Though some are common to all colleges, others are clearly determined by the size and importance of the college. Perusal of the prospectuses of some 220 colleges reveals an extraordinary diversity, both in complexity and standard of presentation. Some are clearly the products of much care and pride, others are no less clearly treated as the ephemeral products of a minimum budget. The contrast with the glossy illustrated editions of the bigger industrial firms is very marked, and while some of these appear to err in the opposite direction it is a poor policy to make poverty everywhere apparent through the prospectus, and a poor compliment to the college. The size of a college and the relative volume of work in full-time, part-time day and evening courses generally determine whether it issues a single or several departmental prospectuses, or again, one for full-time and another for part-time courses. These are justifiable on the grounds of convenience and minimising expenditure, but something is lost if no prospectus is produced for the college as a whole. Equally attractive leaflets should be printed in sufficient quantity for all special courses, including post-graduate short courses. If the college has its own school of art or can secure the co-operation of a neighbouring one, advice and assistance should be sought in matters of design, layout and printing.

As part of good external relations the prospectus should make acknowledgment of the assistance received from industry, in the form of a list of the names of firms granting day-release to students; a list of prizes given by firms and various organisations, visits arranged for students to see work in progress on the site and the loan of special equipment and possibly of research grants and materials.

Press advertisements will mostly be for special events, but will be necessary for routine notices of courses, etc., especially for colleges with a large catchment area. Conferences with industry such as with representatives of firms granting day-release and other interested groups, such as careers masters from the schools, should be held from time to time to discuss new developments and mutual problems. Where it is intended to establish a new course, especially on a full-time or sandwich basis, it is often desirable, after the matter has been approved in principle by the appropriate advisory committee, to hold an exploratory conference of representatives of the leading firms in the industry in the locality or region. By this means the issues can be clarified and problems anticipated, and the members of the conference may then become good exponents of the scheme.

Many, if not most colleges have a special occasion each year when their work and facilities are open to inspection by the public and the employers. Such college open days were mostly started partly to satisfy the interest of students, parents and employers, but also to stimulate recruitment. Surprisingly perhaps, this latter purpose has not vanished, and this because of the national need for trained and educated people. These events may mean some interruption of normal college work but generally they are an invaluable part of college external relations.

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CHAPTER XIX

BUILDINGS AND EQUIPMENT

FUNDAMENTALLY, education is the product or by-product of the personal relationship of two or more people (but probably not too many at any one time). It may be the relationship of teacher and pupil, or it may come through the sharing of experiences, or in the interplay of ideas and emotions between equal though dissimilar people. In this sense and context, bricks and mortar equipment and 'hardware' may be needless and altogether irrelevant. But this will seldom be so in this climate, with the numbers requiring and we hope desiring education, and furthermore with technical subjects to be studied and craft skills to be acquired. For the most part buildings and equipment are of vital importance, not only to the technical competence of our work, but the buildings should also provide the atmosphere and amenities of a stimulating and agreeable college life.

Technical education has never been well blessed in these respects; indeed, there is too much in its history to justify the fashionable title of 'the Cinderella of education'. No purpose will be served by going over the uninspiring unequal record, provided the need is now granted, that the standards are raised high, and that our buildings must not be so skimped and designed as to make poverty permanent.

The post-war rate of educational building, as a whole and of further education in particular is shown in Diagram 33 [1].

The amount of building in further education as shown in Table 51 is undoubtedly much greater now than at any other period and this is very encouraging even when set against the cumulative deficiencies of former decades, and despite the apparent contrast of Diagram 33.

TABLE 51

BUILDING PROGRAMME AND NEEDS IN FURTHER EDUCATION [2]
at end of 1953/4

	Major Projects	
	1953	1954
	£	£
Total completed post-war projects	10,703,000	17,961,000
Total work under construction	16,616,000	13,713,000
Other contracts approved	720,000	1,699,000
Total Major Projects approved	£28,039,000	£33,373,000

By the same date minor projects totalling £3,303,000 had also been approved, making £31·3 millions on further education (excluding teacher training colleges) which made about 10% of the total approved building programme of £338·3 millions on all forms of education in 1953. Though Diagram 33 and Table 51 have value in showing the total expenditure on further education, it is nevertheless very difficult to judge whether this development is a fair proportion of the total expenditure under the building programme. So many factors are involved —the relative backwardness of existing provision, whether technical college work is being carried on in a blacklist school or in a disused partly converted chapel: the pressure of numbers, whether due to the rising birthrate with its inevitable rise in school numbers, or the rising numbers demanding further education—which are not inevitable but which may fall away if no provision is made, with serious consequences on our economic future. Other factors are the relative cost of buildings and equipment, which are very much higher in technical than in primary and secondary education.

No simple calculation in terms of total expenditure is possible; for example, that the approved major project expenditure on primary and secondary education which have 6,360,000 pupils is £223·4 millions, while that on further education is £28 millions, for 57,000 full-time day, 335,000 part-time day and 1,700,000 evening students. It is impossible simply to equate the relative needs and loads of work at so much per head or per student-hour, from school standard to post-graduate level. By the same token, valid comparison with building programmes in the universities is also very difficult to achieve. From 1947 to 1952 about £23 million was approved in respect of university building, plus £4 million for the purchase of sites and properties, and £7 million for furnishings and equipment, and thus for a doubled population which reached a number of 83,458 students [2]. But this was planned for a much higher proportion of research and advanced work than in the general range of technical colleges as a whole. Comparison would be fairer with the regional colleges, but the figures are not available. Nevertheless when all allowances have been made, and despite the progress made, the situation cannot be regarded as satisfactory. Relative to the rest of the educational system in pre-war days, the technical colleges were certainly no better off and the demands upon them have increased over fourfold in full-time courses, seven-fold in part-time day courses and 1·6 times in evening courses (in which the bulk of the pre-war work consisted) (pp. 4–5, 118). Relative to the universities there is certainly at least as much improvement to be made for the regional colleges as Redbrick stood in need of, as shown by the approved building programme. One thing certainly stands out, that it has been possible for the universities to provide excellent student union facilities, residential accommodation and teaching premises for subjects connected in no direct way with industrial needs, while the major, and indeed all technical colleges were until recently severely restricted by the Minister's policy laid down in Circular 245.

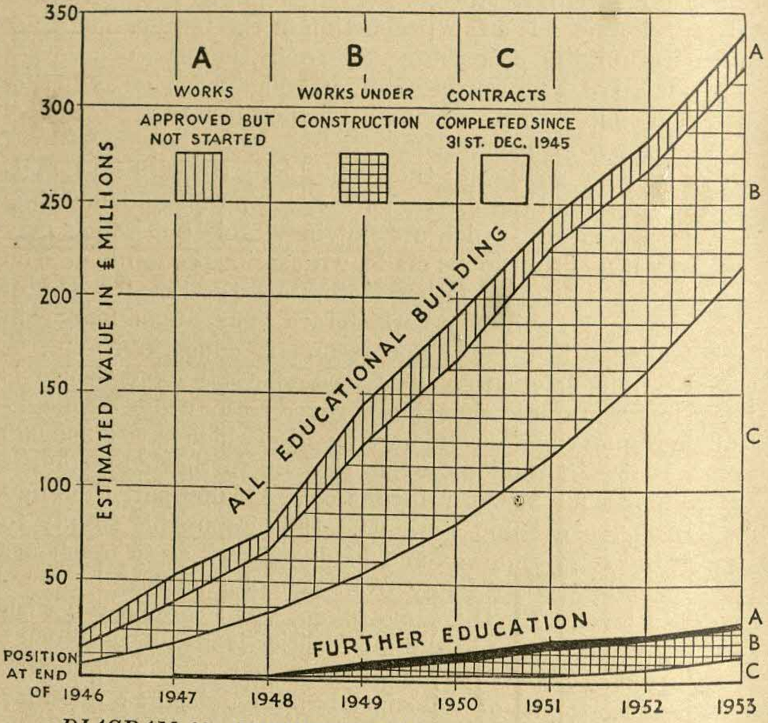

DIAGRAM 33. PROGRESS IN EDUCATIONAL BUILDING
(England and Wales, excluding Universities between 31st December, 1946 and 31st December, 1953)

Total Programme and Further Education Respectively

Source: Ministry of Education Report, 'Education in 1953', Table 75

The needs of technical education for buildings must be considered in the light of the proven demand and the total future national requirements. There is no doubt about the proven demand (Chapter XV) and even if all the means were fully implemented, universities and technical colleges alike, the

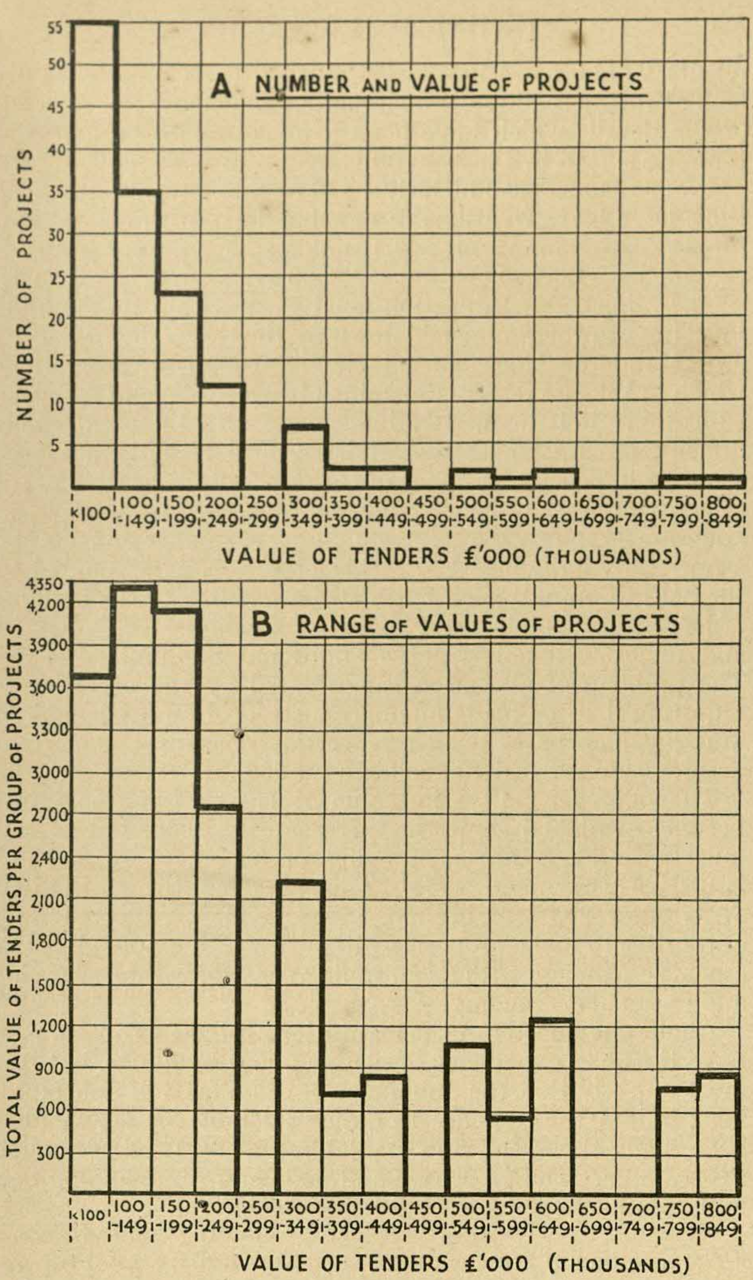

DIAGRAM 34. ANALYSIS OF MAJOR BUILDING PROJECTS (OVER £40,000) FURTHER EDUCATION
(England and Wales, 1948–53)

Source: Information supplied by the Ministry of Education results would scarcely meet the need (p. 19). Before we look at future requirements, let us examine more closely some of the details which have gone to make up the progress of building shown in Diagram 33.

From 1948 to 1953 inclusive, 143 further education institutions have had extensions or new buildings with a total cost for the programme of £23·1 millions, for major projects ranging between £40,000 and £850,000 as shown in Diagram 34.

The Ministry of Education must work within the building investment programme laid down by the Government and by any standards—most of all the re-armament programme which in the last resort is sustained by scientific and technical education—it is manifestly inadequate. In these extremely difficult circumstances the Ministry until recently has been strongly impelled to a policy of the greatest pacification of the greatest number of local authorities and thus to approve, as Diagram 34 shows, the greatest number of smaller projects and a few really large projects. This leads, too, as was noted by the Select Committee on Estimates in 1951–2, to the building of large projects in several phases with cumulative difficulties and disproportionately large additional building costs [3]. The problem of allocation is not eased by the necessity of requiring it to be made annually instead of on a triennial or quinquennial basis, which is certainly a most important desideratum for regional colleges (p. 563).

The figures for 1954 in Table 51 (which have only just become available) show the increase over 1953, but to this must be added the encouraging promise of Circular 283, issued in December, 1954. This removed the restrictions of Circular 245 and invited, indeed almost exhorted local authorites to make proposals without restriction of subject or amenities, though with a continuing need for careful planning and reasonable economy.

About one-quarter of the institutions listed in Table 3, p. 8, have thus had experience of planning new buildings, but it is most unlikely that the remainder have no need of new buildings; indeed the response to Circular 283 by the L.E.As. has been many times the sum available for the 1956-7 Building Programme. The procedure and main steps in planning new buildings may therefore be briefly summarised.

Determination of Need

If existing buildings are grossly overcrowded, only one major issue remains in the determination of need, and that is whether the overcrowding is due to a pent-up demand which will pass, or is due to a permanent demand. The surge of ex-service students into the colleges was an obvious case of a pent-up demand; however the totals of national enrolments did not fall away subsequently but actually increased with a permanent post-war demand for full-time and part-time day courses. This subsequent expansion may be in the same or in different courses, with differing requirements for future buildings, which will differ according to the area or region of the college. In determining the permanently risen demand, an examination of enrolments by courses and catchment area is desirable; by courses, to have regard to any changes in the neighbouring industries, whether as to the decline of old industries or the rise of new industries; by catchment area, to have regard to comparable courses in the other colleges in the region, or again the catchment area likely to justify a highly specialised or advanced courses and the staffing and equipment needed for it.

If existing buildings are not over-crowded, it is not to be assumed that extensions are not justified, but the case is felt to be so much weaker, for it has become almost an unwritten law that the only way to secure new buildings in foreseeable time is to create gross overcrowding if not an educational slum. It is extreme naïvetè to say that a college should take no more students and maintain normal standards *until* a new building is forthcoming; waiting lists vanish to produce overcrowding and thus afford a proof of demand elsewhere or, if the distances are too great, the would-be students do not bother any more. So then there are no students, no demand and so no new buildings are necessary. Few new buildings have been sanctioned until the need has been overwhelmingly evident even to the blind and faint of heart, with the result that they have been too small and out-of-date when, at long last, they have been opened (but note some exceptions, p. 31). Despite talk locally of 'the white elephant', no extensions or entirely new colleges remain empty, and most find that their very newness attracts students in hitherto unsuspected numbers.

New courses, especially full-time and sandwich courses, are more difficult to predict and justify, and these may very well have to be a matter of faith, of supply and demand, not originally justified by demand either from industry or parents. An experiment inherently is open to doubt from the beginning, but should be allowed on a reasonable assessment of the factors for and against its success. What is disturbing is a refusal to experiment, especially when all the signs of national need are urgently in favour of such experiments. A policy of 'bodies before buildings', of requiring a completely proven demand before experiment, will save present pence at the cost of future pounds spent in retrospective development.

All the foregoing issues are fundamental to the future of the college and must be closely considered and resolved upon by the governors and the local education authority. As the investment of public money in a building programme is then proposed, sooner or later these issues must be discussed with the Ministry, and a great deal of unnecessary work in subsequent stages will be saved if H.M. Inspectors are brought in from this early stage onwards.

The Schedule of Accommodation

The next stage is the conversion of enrolment figures and courses, actual and potential, into a list of new rooms required which constitutes the proposed accommodation schedule [4]. Departmental schedules of specialised rooms, workshops, laboratories, classrooms, stores are first compiled, preferably by the heads of departments and senior staff, and each is then discussed with the principal and collectively with the other heads to ensure adequate accommodation for ancillary subjects and to prevent needless duplication. Discussion should then take place with the specialist H.M. Inspectors, and there should follow a joint discussion with all concerned. The resulting draft schedule of accommodation should be submitted to the governors and/or local education authority, and, if approved, thereafter to the Ministry for approval. When this approval has been gained the stage has arrived for expanding the schedule into site and sketch plans of the buildings.

The Appointment of the Architect

If the architect can now be appointed so much the better, for his part from now on is of critical importance and clearly should not be long delayed. He may be the architect of the local authority, in which case he may already have been much consulted and this will readily continue, or he may be selected by an open competition held under conditions laid down by the Royal Institute of British Architects, in which case there will inevitably be some delay in his appointment. However, much valuable publicity will result and—though this is a matter of taste and not of certainty, depending on the standing and competence of the local authority architect—a more venturesome design may possibly result. Whichever method is chosen will depend upon many local factors, some of them quite unpredictable, and each must be treated as a separate case.

The architect must early be seized of the fact that he is not asked to design another school, but a very special kind of institution with a particular character depending on many of the factors in technical education discussed in earlier chapters —a range of studies possibly from elementary to post-graduate level—the very varied types of specialised rooms, equipment and services required, the age-range of students from adolescence perhaps, but certainly including youth and mature adults, the needs of day and evening students and those who travel long distances. The particular blend will be unique to the institution he now serves and his designs and plans should embody its character, a point which should appeal to any architect in these days of mass production and standardisation. To be successful, the planning of the new building must early become a partnership of the architect with the principal and the heads of departments who, with all due respect to the authorities concerned, are his real clients and who will have to educate the students in the new buildings.

The Choice of a Site

In the few cases where the choice is unfettered, perhaps the most important factor is ready accessibility for large numbers of part-time day and evening students, especially if many travel long distances to college. A site at the focal point of road and rail transport is thus largely pre-determined, however otherwise desirable a college on a large but remote site enclosing playing fields may be. For small towns the problem does not arise in the acute form inseparable from industrial conurbations, where far-distant separation of college and sports facilities is inescapable.

The choice of a site in a large town or city for a new building or for extensions is circumscribed with all sorts of difficulties of purchase; of access, frontage, and distance from the main building; of the character of the neighbourhood; 'ancient lights' with a tall building on a restricted site; car parking facilities needed with ever more adult students; and even the rousing of local feelings. More often than not the choice is not of a really first-class site, but of the best available, which confronts all concerned with a continuing challenge to solve their problems despite the added complications from the site. Too many cautionary examples exist to make it superfluous still to add that on no account should detailed planning be undertaken before the site is assured, and before the nature of its subsoil has been determined by multiple extended borings.

Design and Function

The principal and heads of departments must make the function of the institution clear to the architect before he can begin to design the general layout of the building. Regard must be had to the work profiles of the college which summarise the range and timing of its work (pp. 75–77), to the interrelationship of the various main types of accommodation such as classrooms and lecture rooms, specialised rooms (laboratories, workshops, studios, including stores), social facilities (common rooms, refectories) and administration and general facilities (offices, governors', principal's and heads' rooms and staff rooms; committee and conference rooms, main Hall).

Some departments are more closely interrelated in their work than others, e.g. engineering departments with mathematics and science as compared with art, or again, textiles is more closely related with art than with mathematics. These varying degrees of relatedness should be shown by the juxtaposition of the departments in the plans, unless this is prevented by the necessity of keeping certain departments in an old building. The necessity may arise because it is much cheaper not to move a department (e.g. chemistry or engineering), and thus not to abandon or move expensive installations and services. Allocation between buildings and zoning within a building should be planned to secure the maximum use of common services and the minimum sharing of uncommon noises [4]. The flow of students through the building should be envisaged with normal timetabling and at peak loads such as enrolment, the beginning and ending of classes and morning breaks. For large functions, both internal college ones and when the college hall and social facilities are let to civic and other bodies, the arrangements and disposition of rooms should prevent large numbers of people having to traverse the main teaching block which should be kept as separate as possible. The creative work of the architect is in part to resolve the practical application of such principles, to balance many competing technical claims for space, sequence and arrangement, both horizontally and vertically; but it has also a second no less important part.

Design and Aesthetics

Out of all these technical considerations, and within the strict limits of finances, and specified overall dimensions as laid down for example in the Ministry's Building Bulletin No. 5, the architect must exercise his creative art to produce a good building to work in, and this not least because it is harmonious and aesthetically satisfying. Upon his success will depend much of the aesthetic education of the students, whose standards will thus be subtly but permanently raised. If the college is not inferior to the local cinema (to set the standard no higher) in its own appropriate design, in attractiveness and comfort, the young person may rate education no lower than the films, though it is perhaps hoping too much that so many should attend so many times so willingly. That a fine building, efficient and comfortable, pleasant even beautiful in form, proportion and colour, is a continuing source of pride and joy which permeates all the work and activities of staff and students alike, seems too obvious to be stated; but such has been our legacy from the industrial revolution that we have been largely unaware of the ugliness of so many of our buildings and, with depressed standards, have felt beauty to be a superfluous non-functional consideration, and that especially where people study and work.

Prospect is still superior to retrospect and hopes are higher than for many a decade. But the hand of the past is heavy upon all schemes where extensions rather than wholly new buildings are to be planned. The bogey of matching the external appearance and design of the building with those of neighbouring ones raises its undoubtedly ugly head. In most cases the problem is not that of a marriage of styles ancient and modern as in Oxbridge, but of a fresh and heartening break from the surrounding much blackened Redbrick. The form and appearance of the building is the resultant of its internal technical requirements (in all senses), the possibilities of the site, the materials and methods of construction available within the price likely to be approved—a resultant which can only issue in beauty and function through the creative work of the architect.

Problems of Phasing

With the very great demands on limited resources, detailed planning of building programmes by the Ministry is quite unavoidable. This means that large projects must necessarily be completed and therefore be planned in instalments or phases as outlined in the Ministry's Building Bulletin No. 5. Ideally, the phasing of a large project may be solely financial with appropriate allocations from year to year but without interruption of building operations. Otherwise the building operations may be completed in one phase before another is planned and sanctioned. The completion of the first phase and securing it from the weather, and the subsequent restarting of work on the site is likely to prove expensive and has been the subject of severe criticism [3]. But some has been unavoidable because of limited resources, and in any case a large project inevitably means a conflict of interests even within the college. Thus departments, with heavy machinery requiring hard standing which must be in the basement or on the ground floor, tend to get first choice of any new building. These also were the ones favoured by the restrictions of the Ministry's Circular 245, e.g. engineering [5]. The subjects ancillary to these tend to receive the next more favourable treatment, and thus certain subjects such as general education and commerce tend to be the last provided for. A similar pressure pushes social and general facilities into later phases, so that cumulatively more and more students enjoy proportionately less facilities as time goes on. It may well be that local authorities have followed this line too readily and have not pressed sufficiently for the portion of accommodation for social facilities (refectories, common rooms, etc.), which educationally are at least as essential as store rooms and offices.

The problems of phasing will be largely determined by the nature of the site. On a large horizontal site with dispersed sections of work and at most a two-storey building, the phases can be designed and completed separately, with at most some problems of temporary usage of a room or two in one phase to be rectified subsequently. With a restricted site, usually in the centre of a city, a tall building of perhaps as many as six or eight or more floors, phasing produces many more and urgent problems. The design of the steel structure of the building as a whole must be well advanced before the first phase can be detailed; services, supplies, etc., must be designed as a whole, and problems of safety, noise, supplies and services, etc., and for the occupation of the separate phases in turn must be foreseen before a start is made on the first phase.

Problems of Growth

To be successful a college must be responsive to industrial, commercial and general social changes, and even anticipate some of them [6]. Even if its buildings are relatively modern and well-designed it will hardly go a decade without considering some alterations, adaptations or additions. These may be of a major character in providing extensions as already discussed, or they may be of a minor character and come under appropriate regulations. The problem is always how to carry out such work with the minimum disruption of normal work, and the summer vacation is clearly the most desirable period for such work.

Continued piecemeal alterations are rarely satisfactory and mostly more expensive than a well-planned larger inclusive scheme. The choice to be made is one of resources, of the age of buildings to be adapted or added to, and the justification and likely support for a major project—all of which must initially remain matters for local judgement.

Special Rooms, Services and Equipment

So great is the range of requirements here that many large volumes could be written about them [6], providing a summary of the latest professional knowledge and advice and the quintessence of catalogues galore—and the volumes would be out-of-date long before the labours of compilation were completed, so rapid are the scientific and technological advances to-day. Some general points however, justify special emphasis.

The list of equipment and specification of services should first be made departmentally, with full use of specialists from other departments, and the specialist H.M. Inspectors should be consulted at a very early stage. The whole emphasis should be on securing the highest degree of teaching efficiency, and not of simulating industrial conditions, which may emphasise only a temporary phase in a rapid period of change and thus be subject to a rapid obsolescence. The aim should continually be to provide experimental conditions for the study and illustrative application of general principles and skills, not the learning of every fact of an industrial process nor the acquisition of the skills related only to particular operations or processes.

When the general requirements are clear the architect should be drawn in for a critical examination of the problems of installation and of services; of major equipment, requiring large doorways or special foundations or likely to cause special maintenance problems some years later; of the delivery and subsequent movement of bulky or dangerous materials; of rigorously controlled conditions as of temperature and humidity in textiles workshops, of controlled temperature and atmosphere and freedom from vibration and dust as in microchemical and metrology laboratories, or of lighting in art and textile rooms. Ventilation is another matter requiring special attention, as is well known for chemistry laboratories, but necessary also for example in the heat engines workshop, the heat treatment laboratory and in dark-rooms. Safety is an overriding factor of great importance, with certain obvious aspects such as access, loading and fire risks, electric shock, but with many subtler ones which make it advisable to seek the advice of H.M. Inspector of Factories—on one condition. That it is clearly understood that the college is not and cannot be designed as a factory, if teaching is not to be seriously circumscribed. Nevertheless the H.M. Inspector of Factories has a valuable fund of experience and power of critical appraisal which enables him to foresee potential dangers which should be guarded against in some way or another, though not necessarily that which would obtain in a factory.

Furniture should be robust, well-designed and pleasing, and the architect's knowledge and judgement is of great value in advising the principal and his staff. In a scheme of many phases it is important to have ideas and standards quite clear from the start so that there will be no regrets with later phases, either because of lack of robustness or with changing fashions in design. Bulk design and purchase being cheaper are clearly important, but should not be pushed so far as to sacrifice variety and requirements in specialised rooms. Architects should never forget that technical institutions are largely used by adults (pp. 72, 519), and are not schools, and that their furniture and amenities such as students' common rooms, conference rooms, lecture rooms and refectories should be designed accordingly in the most attractive way possible.

Some colleges receive gifts of apparatus and equipment from enlightened firms, but the number could be much larger and indeed might be if it were more widely known that such gifts rank for income tax rebate as set out in the Ministry's Circular 281 [7]. The colleges should not be regarded as repositories for obsolete or obsolescent equipment, though occasionally a particular piece may have a special value for teaching. This attitude has nearly gone, but we have still to establish the tradition that where they are suitable for teaching purposes, the first products of production are to be found in the technical colleges. Firms can also help greatly in the loan of equipment, especially for research and special investigations, and also by rental at nominal terms of large or very expensive equipment, each piece to be replaced by the new model when it first comes on the market. Some firms seems strangely oblivious to the advantages of bringing their products early to the notice of the rising generation of scientists, technologists and technicians.

Residential Accommodation

The value of residential facilities has already been stressed (p. 472); at any rate for the regional colleges gathering students from far beyond their own immediate locality, and even from abroad. As these colleges become more fully recognised for what they are, they will recruit still more widely and especially for sandwich courses and post-graduate courses. The problem is how to meet this need with such pressure on building resources at the present time, and with seemingly prohibitive building costs. The simplest temporary solution is the conversion of large mansions, but this depends on the kind of region in which the college is situated and what remains after the post-war acquisitions made by nationalised industries and large firms, with financial resources far greater than those of technical education. An enlightened day may come when such accommodation will be agreed to be as important as that for the teaching of science and technology. Already it is being stressed to this degree by industrialists, partly in their support of residential educational ventures (p. 192), and by a strong preference for the residential ancient universities. This requirement of residence was understandably emphasised strongly by F. H. Perkins and placed by him first in future requirements [8]. We can have the fullest sympathy with this view but, with present day unfavourable prospects, we can only hope that it will not be rigorously insisted upon as a prime condition, which would be greatly to the detriment of technical education. After all, great numbers have succeeded without its benefits, and the universities are far from perfect in this respect as shown in Table 52 [9].

TABLE 52

ANALYSIS OF UNIVERSITY RESIDENCE
(Great Britain, 1952–3)

	Great Britain		Oxford and Cambridge		Great Britain excluding Oxford and Cambridge	
Kind of Residence	No. of Students	% of Total	No. of Students	% of Total	No. of Students	% of Total
Colleges/Halls of Residence	22,269	27·3	7,977	54·3	14,292	21·0
Lodgings	32,559	40·0	6,455	43·8	26,104	39·0
At Home	26,646	32·7	285	1·9	26,361	40·0
TOTAL	81,474	100·0	14,717	100·0	66,757	100·0

The major colleges do not yet compare even with Redbrick, though a number have hostels and most of them have schemes of registered lodgings. Altogether there were not less than 5,075 overseas students in attendance at British technical institutions in 1952–3. The need for residential accommodation is thus self-evident and is most needed at regional colleges. However, present lack should not hinder future developments and recognitions in technical education, for we may note the wisdom of Sir Winston Churchill's remark, 'It would be an inconvenient rule if nothing could be done until everything can be done.'

REFERENCES

1. *Ministry of Education 1952–3 Report*, Table 75.
2. *University Grants Committee Report, 1947–52*, §139.
3. Fifth Report of the Select Committee on Estimates 1951–2, *The Grant in Aid of Universities and Colleges* (H.M.S.O., 1952).
4. Ministry of Education Building Bulletin No. 5, *New Colleges of Further Education* (H.M.S.O., 1951).
5. Ministry of Education Circular 245 (4th February, 1952), §19 (H.M.S.O.).
6. With such rapid developments the professional and trade journals form the best source of up-to-date designs and information, e.g. *The Journal of the Royal Institution of British Architects; The Architect and Building News; The Architects' Journal; The Builder; Building; Education* (the *Further Education* supplement).
7. Ministry of Education Circular 281 1st October, 1954: Treatment for Income Tax, Profits Tax and Excess Profits Tax of Gifts, etc., by Traders to Technical Colleges, etc., for the Purpose of Vocational Education or Reseach: This covers only contributions towards current costs and to capital costs; gifts of equipment; loans of equipment; payment of fees; gifts, etc., for research.
8. F. H. Perkins, 'Industry and Technical Colleges', A.T.I. Paper, June, 1954.
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CHAPTER XX

CONCLUSION: OUTSTANDING PROBLEMS AND PRESENT OPPORTUNITIES

WHATEVER else may be said of technical education, it lacks neither problems nor promise. This is not surprising, for all education embodies the thought and values and continues many of the practices of bygone years, adapts them to the needs of the present, and transmutes some perhaps in reaching out to the future. Whatever may be the degree of correspondence of other parts of the educational system to the needs of contemporary society, it could scarcely be closer than it is perforce with technical education. And herein lie both its problems and its opportunities.

It is a pardonable vanity of an era to imagine that never before has mankind been faced with such pressing problems, beheld such amazing changes, or been haunted with such hopes and fears for the future. Nevertheless this era will compare with most, and its changes have certainly affected the greatest proportion of the earth's population at any one time. What is more, through the means provided by applied science and technology, the peoples of the world have become more quickly and more acutely aware than ever before of the far-reaching and far-distant changes, events and ideas, produced or promoted by the application of that self-same science and technology. Change has always been a constant challenge to and preoccupation of poets and philosophers: what is new and profoundly disturbing is the fantastically increased rate of change. Some effects are at once dramatically evident to all; others, especially the dissemination of libertarian ideas, are subtly cumulative with pent-up energies explosive in the historic events; all may be most impressively seen in retrospect.

In this reflective vein Sir Norman Kipping began his summary at the recent F.B.I. Conference on 'The Technical Colleges and Industry':

> Do let us reflect for a moment on the climate and conditions in which we all live.
>
> Within the lifetime of many of us, the internal combustion engine was a novelty; radio (except for spark transmitters) was

unknown; reinforced concrete and almost all other plastics had not arrived; there were no aircraft; the electric power consumption of the country was a few hundred thousand kilowatts; it was about 1925 before you could telephone Paris; canned foodstuffs were suspect and a novelty; Henry Ford had not invented his concept of flow production methods; income tax was about a shilling; the most extreme radicals of the day were far to the right of the present Conservative party; the United States was a debtor country; there was widespread general unemployment; hours of work had recently fallen from 72 a week; you could travel anywhere without a passport and it was a Free Trade World.

All that would be about 50 years ago. If I took it only 15 years ago, the list of changes would still be colossal, particularly technically and economically. And now, standing on the brink of the consequences of atomic fission, whose *peaceful* consequences may I suppose be of about the same order of magnitude as the discovery of steam, who can doubt that the acceleration of technical complication will continue [1].

As we move forward, willy-nilly it seems, into the atomic age, the physico-chemitechnic age (p. 38), what must be the essential characteristics of technical education and what may be the growing points of change in the system itself? Prophecy may be presumptuous, but speculation is an indispensable stimulus to the human intellect and spirit; more, it is both a right and a condition of its development. Though our time-scale for prospective development is minute compared with *The Next Million Years* of Sir Charles Galton Darwin's book, in our own small way we can take courage from his standpoint:

> The spirit of criticism is much commoner in the world than the spirit of invention, and progress has often been delayed by authors, who have refused to publish their conclusions until they could feel that they had reached a pitch of certainty that was in fact unattainable. Progress in knowledge is more rapidly made by taking the chance of a certain number of errors, since both friends and enemies are only too pleased to exert their critical faculties in pointing out the errors; so they are soon corrected and little harm is done [2].

If we are to meet 'the challenge of change' we must have education both for flexibility and quality. Though these are seldom separable we may consider them so. Unexamined traditional methods, whether of training, production or distribution, will no longer suffice. Inherent in such methods is the inevitable time-lag of cumulative practical experience, which often becomes so much a matter of pride as to ensure their continuance despite an ever-increasing need for change

[3]. 'The practical man', said Kelvin, 'continues to practice the errors of his forefathers'; and to these the 'practical' man adds the gross errors of ignoring change and the need for new knowledge and skills. The number of such impractical men must surely be diminishing, but hardly at fast enough a rate. Not only is there a need for re-training to acquire modern skills, but also education to inculcate a readiness to discern and accept the direction of change. This may mean changing jobs with changes in markets and production, or acquiring other skills to be able to undertake a range of jobs with economy of time and manpower; or yet again, and more formidably, discarding restrictive practices, defensively devised in the days of unemployment, for the flexibility of full employment.

Exacting though these may be, greater demands may be made, particularly in the need to urge people to move from the accustomed area (however heavily industrialised and smoke begrimed), and in having to make friends in a new place. This may well happen first with the exhaustion of natural resources and their development in other places (as with coal and iron); secondly with the freeing of many industries from the immediate location of natural resources (as with electrical engineering and through atomic power), or the generation of new industries from imports (as at Fawley, Stanlow, Coryton and Partington, all remote from the oil fields of the world); and thirdly, with the substitution of new materials for old (as with man-made fibres in place of silk, wool and cotton, and of plastics for other materials). These are but three main trends, and the first has faced mankind even from nomadic times. But the second and third belong to this age and have ever-increasing impact, especially when we add a fourth—the substitution of new sources of energy for old, which brings us right into the atomic age. It is almost as if mankind were by a spiral of history reaching new nomadic times [4].

But increased flexibility cannot result from education without a simultaneous increase in quality, and for present needs in three main ways. The first is the urgent need for continued general education by lengthened schooling, and beyond. It is often overlooked that those in positions of affluence or authority have seldom denied their offspring as good and long-continued an education as possible; those who have had a good education mostly wish and strive for a better education for their children—as the middle classes continue to do despite mounting taxes and parental means tests for scholarships, which make an Irishman's rise a commonplace. The example of the 'haves' should not be lost upon the 'have-nots', for nothing could be clearer than that to be deprived of education is to be all but deprived of opportunity. All this may be regarded either as social envy or social emulation, but those concerned with education need not be too purist at this stage so long as there is more of education.

No one engaged in further education should be deceived on this question of general education by any short-sighted industrialist, or by any hard-pressed parent wanting relief, or by an ignorant one grasping an additional wage-packet, especially in these days of high juvenile wages. Indeed none are likely to be deceived, for the lack of a good education is all too frequently seen to retard the progress of young students, and to hamper their subsequent careers to positions of responsibility. And let there be no mistake, this applies not only to the potential technologist of whom we hear so much nowadays, but to the far greater number who must be found to continue the great bulk of the world's work in many industries and a myriad occupations. For these reasons many believe that if the choice should be one between raising the school leaving age to sixteen or starting county colleges, the former should prevail on two conditions. A more determined effort should be made to end inferior conditions of staffing and buildings and other amenities, and to encourage appropriate courses and especially a marked increase in secondary technical schools and courses (p. 100). Thus those teaching in further education would have firmer foundations for their work, and the students would be more able to cope with the exacting demands of further education, especially those of part-time courses.

The net effect would be an all round increase in quality of education and of work. To those who querulously ask 'Who is going to do the unpleasant and dirty jobs which have to be done?', the answer is clear enough. It is that many such jobs formerly justified in such terms have long since ceased to be done, and that a shortage of labour and a better standard of education have already removed or transformed many such unwelcome tasks. There is no sign that we are at the end of this process, especially on the threshold of the automatic factory in the atomic age, and the higher proportion of full-time and advanced education in other countries should make us ponder whether our tasks are so different or our people so lacking in capacity.

If increased general education is a prime condition of increased flexibility and quality, increased science is the second, not far behind in importance. Scientific knowledge is invaluable, but scientific thought holds a key position as the *lingua franca* or *via media* of the technologies (p. 427). The gains from acquiring the scientific attitude of mind in trying to solve problems have been tremendous but are immensely far from being exhausted. This is true in so many spheres—whether it be in the improvement of established processes and manufactures, and in developing new ones, as for example by the method of combined operations known as 'operational research' [5]; whether the approved application of science should come by a survey of the scientific staffing of industry, since this is of cardinal importance, as the Manchester Survey, *Industry and Science*, has shown [6]; or whether in a detailed examination, as by 'case-studies' of the attitude of particular firms to particular scientific and technical advances, for which a special committee was set up by the British Association in 1952 [7]. Developments are taking place through the use of special funds, e.g. the so-called Counterpart Funds for research and advice on improving productivity [8].

Another way is through the work and recommendations of the Advisory Council on Scientific Policy, which has published important Annual Reports over the last seven years [9], while yet another is a close examination of the obstacles to the rapid translation of the results of research into industrial practice [10]. All these newer means and studies have been added to the long-standing and invaluable work of the Department of Scientific and Industrial Research and the Research Associations [11]. Important as all these means and agencies of increased application are, our concern here is with the inescapable conclusion that the more they succeed in their purpose, the greater is the need for extending the means for scientific and technological education and above all, for inculcating the scientific attitude of mind in as many students as possible. This applies at the technician and craftsman level as well as for technologists, and is in fact already taking place (p. 450).

The third condition of flexibility and quality, to be secured through education, is the fostering of personality and character, the education of the emotions as well as of the intellect, the strengthening of the will and personal integrity [12]. It is the fostering of the qualities and sympathies upon which human society does and must always depend, for example in attitudes to work [13] and in co-operating in voluntary and social work, and whose encouragement is an equal condition for the happiness of each individual. With few notable exceptions, industry has shown little concern for this aspect until its recent belated interest in management problems. This interest has come largely from the critical shortage of skilled and responsible people, an acute total shortage of manpower and the slowly growing realisation that, given the best possible machines and processes in the world, their successful use and application will still largely depend on the attitudes and outlook of the workers—upon the quality of the workers as people, not as mere appendages to machines [15]. Increasingly, it has become realised that 'There are no unskilled jobs, only unskilled men' [14]. The prime aim of all management training is increased productivity, which is a heightened emphasis on a long-neglected theme. In an Address on behalf of the National Association for the Promotion of Technical Education in 1887, Professor T. H. Huxley said, 'The object we have in view is the development of the industrial productivity of the country to the uttermost limits consistent with social welfare' [16]. Today we need to go to these limits in order to secure the continuances of even our present standards of living and social welfare.

No one in technical education need, or few can maintain a 'holier-than-thou' attitude to industry in this regard, as an examination of the content of courses designed solely for technical training would show, or of the conditions under which such training rather than education is conducted. While as with industry notable exceptions to the general trend certainly exist, we may merit a severer judgement as our business is or should be with education not directly with production and commerce, with education in which efficient technical training should have its rightful place. Furthermore, technological developments increasingly concentrate power in the hands of the State, and its abuse can only be prevented by a better education for all. To paraphrase Disraeli, on the *liberal* education of its people the future liberties of this country depend. But the means to achieve these wider aims have never been readily provided and until recently have been greatly restricted if not entirely prevented by the operation of the Ministry's Circular 245, and this despite the incontrovertible fact that increased productivity is at least as much a matter of the quality of people as of machines and processes. Yet, as we have noted, we go on training more and more students than ever in more and more laboratories and workshops than ever before with proportionately less and less general and social facilities than ever before, when indeed they are all too scarce.

With all the scientific and technological developments go even greater changes in the rising populations of the world, due to the increased standards of living which these self-same developments make possible; still more are they due to the removal of natural checks to the increase of population, which recent advances in sanitation and medical science have brought about. Many can see in such increases a growing threat to our standards of living, and even to our very existence in their urgent demands on slender world food resources. As the most pessimistic supporters of Malthus would persuade us 'more productivity and less re-productivity' may be required, but we should remember the early unfulfilled prophecies of calamity, as in the prediction of a shortage of nitrogenous fertilisers before the fixation of atmospheric nitrogen was perfected on an industrial scale [17]. We should rather regard the present situation as a stirring challenge to science and technology and, above all, to education in helping forward the economically backward countries to make the most of their resources (not merely to exploit them), and to foreshorten their industrial revolutions without repeating the many glaring errors of western nineteenth-century civilisation [18*a*]. This development of offering education to students from such countries, both within and outside the British Commonwealth, has become very marked in recent years, and it is noteworthy that in 1951–2 there were more than 5,000 oversea students attending courses in British technical colleges [18*b*]. Far from being xenophobic, we should welcome them so that they, the future leaders of their countries, become familiar with our methods and products and sympathetic to our ways and ideas [18*c*].

Of the urgency of such national and world problems, and of the scale of development required to meet them, there is a growing awareness which might soon reach almost to unanimity [19]; but the truly thorny questions which remain to plague and perplex us, are those of the means to be employed and the disposition of seemingly scanty or undeveloped resources among them. In trying to envisage future trends we must perforce be content with the national level and below, glancing only occasionally at the international scene.

Over the last half-century and especially in the last decade, there has grown up a fairly close but varying relationship between industry and the colleges, but much improvement is possible. This can hardly be denied when so few of the directors and leaders of industry ever visit the colleges [20], while comparatively few colleges have advisory committees (p. 134), when many more staff should visit or re-enter industry, and while interchange of staff between industry or the research associations and the colleges is practically non-existent (p. 213). Such interchanges would be especially valuable at the research level, for this too would promote what is certainly needed, the supply of research problems and secondment of staff under an extended system of sponsored research, with grants either from the D.S.I.R. or payments of salaries by the firms. The growth of such national institutions as the Imperial College of Science, the Manchester College of Technology and the Royal Technical College, Glasgow, should certainly not preclude nor make less desirable the further development of research programmes at the regional colleges. The same applies also to post-advanced or post-graduate courses, both day and evening. With colleges of art there is a like parallel, in that the re-orientation and development of the Royal College of Art absolves neither industry nor the regional colleges of art from an even more intense concern with all aspects of commercial and industrial design, which is of paramount importance to our economic survival. By the same token, too, much greater attention must be given to training in administration, distribution and marketing, and in all these the major colleges of commerce will have a vital part to play, but it must be in close co-operation with industry and commerce.

This co-operation must obtain not only at the highest levels of work but appropriately at each level and for each industry or main occupation. We can expect an increasing number of schemes of training and apprenticeship to be set up under the National Joint Industrial Councils (p. 190), but we may wonder whether this can yet be combined with more flexibility to produce more handymen. Despite the outstanding work of Sir Frederic Bartlett, F.R.S., and his collaborators, the nature of skills and of craft training are but imperfectly understood and insufficiently appreciated in teaching. If they were, and if the possibilities of 'transfer of training' were utilised, it is tolerably certain that the period traditionally required for apprenticeship could be materially reduced. This would have several advantages, chiefly in preventing any difficulties if boys stayed on longer at school and started their apprenticeships later than usual, but also in making it possible for other skills to be acquired in the same training period with enhanced capacity to meet modern varying demands—the flexibility of full employment already referred to. Unless there is a concomitant change of attitude there is likely to be an uneasy period with the trades unions. The recent local protests against certain courses in hairdressing and against self-help courses in home decorating and repairs, are straws in a wind which could certainly do more than merely ruffle the surface of good relations with industry [21].

These relationships, and also those with the schools, will markedly continue to affect the recruitment of students to the colleges at all levels. Enrolments in full-time courses have increased greatly since pre-war days (p. 4) and with the influx of ex-service students rose to a then maximum of 54,046 students in all establishments in 1950. There was a slight recession (to 53,083 in 1951) but since then there has been a growing increase (by 214 in 1952 and by 2,464 in 1953) to a new maximum of 59,181 students in 1954. The temporary post-war bulge has thus been overtaken by a peace-time expansion and, encouragingly enough, the increase of recent years has been more than maintained. Nevertheless, the rate ought to be still further increased in two main ways. The first is by transference of able students from part-time courses to full-time, and sandwich courses, which needs much greater support from industry and also in financial grants such as a Technological State Award from the Ministry, and from the Local Authorities (p. 526). Unless these threefold courses of support are greatly increased, these recent promising developments will tail off into a wholly dispiriting frustration.

Though the number of full-time students has increased, the number in advanced courses equivalent to university undergraduate courses declined from 9,567 to 8,643 in 1953–4 [22]. There was a very slight decline in science and technology in the universities in England and Wales from 22,686 to 22,398 [23]. Numbers in equivalent part-time day courses fell from 28,505 in 1952–3 to 26,762 in 1953–4, and in National Certificates awarded from 12,168 to 11,285 in 1952–3 with a probable subsequent decline in Higher National Certificates [22]. When these declines are viewed against the total requirements of industry and government to-day (pp. 453 *et seq.*) we must wonder at the lack of a sense of urgency displayed in many quarters. The contrast between demand and supply in a world of increasing competition is most marked and yet strangely fails to be compelling. There is urgent need for greater understanding by the schools of the opportunities and satisfactions afforded by careers in industry, and through full-time and part-time education in the technical colleges, which cater for by far the greater number of their pupils who have continued education. Conferences of headmasters and principals, visits of heads, staff and pupils to the technical institutions, collaboration of heads of departments and careers masters, are some of the ways in which the schools and colleges ought to be brought more closely together.

The significance for technical education of the recent Report on *Early Leaving* needs to be emphasised [24]. The Central Advisory Council for Education (England) therein state that 'All schools except those with an exceptionally high level of selection must allow for a large measure of leaving at 16 . . .' [25]. Furthermore, after asserting that 'The value of a school life extending beyond 16 years depends on the character, and particularly the intellectual ability, of the particular child' [26], the Council expresses the opinion that 'it seems likely that less than half of the present intake into grammar schools could profitably take sixth form courses' [27]. There are many implications here which will have to be faced in the next decade.

If half are unsuited to sixth form courses, what of the validity of the original selection at eleven plus? For what proportion of these would a secondary technical course have been preferable, and more likely to provide a suitable sixth form? In which case it is scarcely valid to argue for an increase in *both* forms of secondary education. For those who do leave at or before sixteen, the technical college has in fact acted as the retrieving mechanism (pp. 15 *et seq.*). But there is little doubt that it could be enabled to act more effectively in this way by better liaison between schools and colleges. Far more parents need to realise that the part-time route now provides at a later stage a way back into full-time and sandwich courses, and thus an excellent route to professional status. Again, how many of the half who stay will go, as is commonly assumed, into the universities, and how many, for example, into full-time and sandwich courses in the major technical colleges?

More important in some ways are the new examinations available at sixteen for the General Certificate of Education, Ordinary Level, organised by the Associated Examinations Board [28], and also the examinations of the Joint Matriculation Board and the Union of Lancashire and Cheshire Institutes (p. 149). Having regard to the present contribution of secondary technical and secondary modern schools to technical education (p. 224), it will be very surprising if many more qualified recruits will not be forthcoming in the future, with undoubted advantage to students and colleges alike. It should be noted that secondary modern pupils are already taking the G.C.E. at both Ordinary and Advanced Levels [29]. The dissatisfaction felt about the lack of a school leaving certificate is leading to arrangements between local authorities and examining bodies, such as the Royal Society of Arts, the College of Preceptors, and the Union of Lancashire and Cheshire Institutes, for them to be awarded on appropriate examinations [30]. As some of these are specifically designed for those entering industry and commerce, they are bound to become effective incentives and in due course benefit both students and technical education.

Expansion has continued in part-time day courses, but despite the gratification this has caused, the general picture will probably remain depressingly like that shown in Diagram 10 (p. 108), still with about seven times as far to go as the progress already made with the county college age group. The contrast with Germany, and with the recovery of Germany to which such training is an important contributory factor, makes many a visitor to Germany wonder who won the war. Germany has hitherto been spared the commitment of men and materials in post-war armed services, with their indispensable but extremely costly equipment which has limited our resources, but we may still wonder at the blindness which persists in not seeing what it cannot afford to be without; the Nelson Touch may well ignore our economic nemesis. The shelving of the county colleges has been perhaps the most bitter of the post-war disappointments, fully justifying the cynics with their ineradicable memories of the failure of the Fisher Act. We now seem to have given up fighting even the last war but one, and we may wonder if we shall ever see a government with the wisdom and courage to establish county colleges.

Certain it is that we shall never establish them on a voluntary basis for more than a small fraction of the age groups 15 to 18 years (pp. 197 *et seq.*), but the position may well become worse once 'the bulge' works its way out into industry and commerce, and in the mid-1960s we may see a recession with too many young people chasing too few jobs. If cynicism has been so well justified in our recent educational history, it may be an unpalatably safe bet in the next decade. It is arguable that this should be the last moment to fold up training schemes which are an essential investment for future recovery and advance, not merely a regrettable liability [31]. It is even more arguable whether industry really knows what it wants in the next decade, let alone in two or three decades hence. The slow expansion of day-release over several decades and its small coverage even now, the long delayed expansion of sandwich courses from 1903 to their rediscovery in the 1940s, the tardy interest in management training and in providing well recognised means of advancement from all levels within the firm, the slow growth of research associations and of interest generally in research, the inertia against introducing new methods and machinery—these paint in the retrospective picture and we may well wonder whether another drawn twenty years hence will show substantially the same outlines. But we must resist the pleasures of hindsight and admit that the signs are more encouraging for many reasons, and particularly so in the development of sandwich courses and in post-graduate refresher courses.

The growth of sandwich courses leading to professional status is likely to be a major development of this decade and already big firms are making arrangements with certain colleges for large numbers of students, e.g. the General Electric Company to the Birmingham College of Technology, the British Thomson-Houston Company to Rugby College of Technology, and Metropolitan-Vickers Electrical Company to the Royal Technical College, Salford. Some firms supporting such courses are paying wages and fees during the six-month periods in college over four or five years [32], and middle-class parents are beginning to realise that these wages are not reduced in accordance with a parental income scale, as is the case with State and local education authority scholarships.

One of the present trends is the differentiation which is taking place between technical institutions to meet the ever-growing specialist needs of industry and commerce. This has been a feature of the history of technical institutions, wherein they have evolved into technical, art and commercial colleges, polytechnics, monotechnics and so forth to meet local and regional needs. This characterisation of a diversity of institutions is now being succeeded by another, namely, into a hierarchy of institutions, adumbrated in the Ministry's pamphlet No. 8, *Further Education* (§208). More and more local technical colleges are becoming and are adopting the title of a 'Local College of Further Education'. Others, of intermediate size or scope of work, are well established area technical colleges, while a small minority, by virtue of their advanced and post-graduate work, constitute *de facto* regional colleges, whose existence is recognised as such by title by the

Ministry of Education for colleges of art, but not yet for technical and commercial colleges. This next stage of differentiation of technical colleges by quality of work and amenities in sufficient quantity has produced vigorous controversy, based largely on a falsely egalitarian fear of excellence (if it should exist, it should not be seen to exist separately).

The main conditions for the emergence of regional colleges are clear enough; (i) a very large 'catchment area' of industry and commerce, sufficient to provide satisfactory numbers of students at advanced level; (ii) a high standard of staffing and equipment in the particular technology; (iii) the co-existence of several such technologies and of related sciences (e.g. chemistry, physics and mathematics) with the same high standards of provision throughout; (iv) the co-existence of adequate research work and post-graduate courses along with undergraduate courses; (v) that the co-existence in (iii) and (iv) is indispensable to maintaining the high standards of staffing, teaching and research required in any one science and technology; (vi) that the resources of men and materials required to meet the foregoing conditions are very strictly limited and are likely to remain so in the future.

It is against this background that the account of the controversy over higher technological education given in Chapter XV should now be considered and especially the conditions of recognition respectively for increased grant under Circular 255 and for the recognition of courses for a new national award of Dip.Tech. (p. 578).

In regard to increased grant, applications for recognition were made in 1954 in respect of 79 technical colleges in England and Wales, and of these the approvals covered 382 courses at 20 technical colleges in England and 25 courses at two colleges in Wales. Circular 255 does not apply to Scotland which already has its fully recognised central institutions (Appendix, p. 606). The 1953 Report stated 'The applications which were rejected failed for various reasons, e.g. the status of the college concerned, the conditions of staffing, equipment and accommodation, the standard of courses submitted and the type of course' [33]. It perhaps would be unwise to read too much into the order and sequence of these conditions, but it is very interesting that neither the Circular 255 nor the Admin. Memo 436 so much as mention 'the status of the college'. The latest number of colleges listed is 24 (Appendix, p. 607), which should be compared with 'Some thirty colleges (which) have been planned to develop ultimately into advanced regional colleges' as stated by the Lord President of the

Council (p. 477). Having regard to the conditions (i) to (vi) above (p. 577) we may doubt how realistic is the recognition of isolated courses, and wonder in how many colleges conditions (iii) to (vi) will allow of full attainment of regional college status; it is difficult to believe that these can ever approach 30 in number.

Now that a new national body is to be set up with Lord Hives as its first chairman, as announced by the Minister on 14th July, 1955 [47] the conditions which it lays down for the recognition of courses for the award of a Dip. Tech. will be awaited with the greatest interest, especially as to their stringency. If these conditions should prove to be a recognition of the existing operative factors (iii) to (vi) above, then the net result would be a *de facto* recognition of colleges rather than courses. Perhaps there are, after all, more ways than one to the same goal, and this would be to carry a stage further the way in which the Ministry has been subtly doing good by stealth under Circular 255 in the cause of recognising colleges via courses. These conditions have already proved sufficiently vigorous and selective as to arouse criticism from local education authorities [34].

In the recent controversy those in favour of the National Award of Diploma in Technology have always claimed that it forms the next stage of an evolutionary process; they have also used many occasions to denigrate the 1954 Policy Report of the Association of Technical Institutions (p. 491) and the 1954 Memorandum of the Parliamentary and Scientific Committee (p. 473), especially those proposals limiting the financial responsibility and control of local authorities, as revolutionary [35]. Such protagonists fail to realise that we have not all of geological time available in this rapidly changing world, and fail also to show any awareness of the critical importance of mutations in the evolutionary record. Now that a decision has been taken in favour of a new National Award, those engaged in technical education must make of it what they can, and we must hope that goodwill and understanding will be shown on all sides to make the next typically British pragmatic phase one of real advance. Assuming this, it is quite possible to discuss ways in which both sides might be reconciled as, for example, in the following conditions:

1. A college with a substantial volume of recognised work should be recognised as a regional college of technology (compare the regional colleges of art), and no other college should be so styled.

2. A regional college of technology may have its own Associateship recognised and accepted in lieu of the National Award.
3. It should be open to a regional college, but preferably all of them in consultation, to determine the nature and nomenclature of their post-graduate awards.
4. The regional colleges should have substantial direct representation on the national award-making body, one representative each on any academic board it may establish, together with representatives of the main professional institutions, the Royal Society and some nominees of the Minister.

Important though higher technological education is, it must not be allowed to overshadow the great and growing importance of technicians and craftsmen, and the urgent need to improve and extend their training. This affects the generality of colleges and is vital to the drive for higher productivity for, as Sir Norman Kipping has insisted:

> It affects not only the managements and technologists, but all ranks of industry. It involves new sorts of specialisation such as work study, methods study, mechanical handling, planned maintenance, management accounting, production control, foremanship training. In many of these, none but the technical college can provide the technical training courses required [36].

We may thus expect to see new intensive methods of operative training [37] and changes in the character of hitherto well established courses. Thus the recent Interim Report on Courses for Electrical Technicians of the Institution of Electrical Engineers reads:

> It is not envisaged that the technicians' course should replace the Ordinary National Certificate Course or other courses which at present meet the special needs of some electrical technicians, as, for example, those leading to City and Guilds Certificates in Telecommunications. There is in fact a need for more courses of this kind and the City and Guilds of London Institute may well be prepared to develop them. *National Certificate Courses in their present form may give place to sandwich courses and these may ultimately become the normal route for student apprentices to professional status* [38] (present author's italics).

It is likely that these trends for one major technology will be paralleled in others; if so, nothing could more quickly affect the development of sandwich courses, altering the character and load of full-time and part-time work, and with it the scope and character of our technical institutions.

The quality of work in a college, of whatever kind and at whatever level, is directly dependent on the quality of the teaching staff in virtue of their personalities and characters, their competence in their own subjects and as teachers. Teaching is a true vocation, but its material rewards can never compare with those available in industry and commerce. This is no new problem, for example Ben Jonson in 1641 said that:

> The price of many things is farre above what they are bought and sold for. As *Learning*, and *Knowledge*, the true tillage of the *mind*, we have from our *schoolmasters*. But the salary never answers the *value* of what is received.

And the very next year Thomas Fuller said that:

> . . . others use schoolmastering only as a passage to better preferment, till they can betake themselves to some more gainful calling [39].

The direct and intimate relationship between the colleges and industry makes the gap in salaries very marked, and may be such as either to put a very heavy premium on a sense of vocation or to attract only the refugees from industry. The 1951 Burnham Award reduced the gap considerably at that time, but it has widened again for the higher posts as compared both with industry and the universities. The latest Burnham Technical Report of 1954 is quite inadequate to attract successful people from industry. But the gap would never be completely closed except by one arrangement in which we would do well to copy American practice, that is by encouraging senior staff to act as consultants to industry without severe restrictions as to salary and conditions of service. This would also encourage the interchange of staff between the colleges and industry and with research associations, which is a glaring gap in present arrangements. A greater development of research in the major colleges would clearly help in this process.

The quality of teaching is markedly improved by training and there is a need for further extension of present facilities, in full-time courses at the training colleges for producing trained qualified teachers, in developing the new in-service teacher courses and courses for part-time teachers in accordance with the City and Guilds syllabuses. The proportion of trained technical teachers is very small, and while it is undesirable and unlikely that every teacher in technical education should be required to be trained, there is nevertheless good room for a marked increase over the next decade to the undoubted advantage of the students.

There is urgent need for more research into the teaching situation in technical education, not least because of its close concern with the inculcation of skills. Closely related to this is the need for research upon the selection and placement of students in courses and in employment, into educational and vocational guidance, for which the college would form a most useful but almost neglected laboratory for investigation [41*a*]. A danger exists in that by pressing for so much research for industry we may entirely neglect research into our own work. Such research, statistical, educational and psychological, could contribute greatly to the efficiency of our work and the well-being of our students, and it could well be organised in a department of social studies. At present, too, we certainly tend to take the whole process of teaching too much for granted, to create our own headaches and still reserve the right to complain. Though it does not warrant the worst interpretations customarily put upon it, the so-called 'wastage of students' is an instance of this. It certainly needs further research into its causes, educational, psychological, and social, and more experiments such as appointing a psychologist to the staff of a college as a student counsellor at least on a part-time basis. Related to this is the need for training in the administration of colleges, of the kind provided in the recent course for heads of departments, held at Garnett College [40*a*].

The technical teacher training colleges ought to become vivifying centres of educational research and be staffed for the purpose, but there is also a stirring of interest in research into our problems in some university departments and institutes of education. This is welcome, not only because it is desirable to have such researches broadly based and linked with a research tradition, but also because of the changing contribution of the universities in the schools or institutes of education established as a result of the McNair Committee Report [40*b*]. They are thus bound to become increasingly concerned with the schools at large, including secondary technical schools and technical courses in bilateral and other schools. The universities also make a contribution to the staffing of technical colleges, particularly in supplying graduates for the teaching of science, English and modern languages. With the broadening of courses and especially with the increased introduction of social studies, their contribution will undoubtedly increase. It should not be made unwittingly or unwillingly, but should be foreseen and encouraged, and be the subject of research and further study in conjunction with the colleges concerned. At the moment the impression could easily be formed, and especially from the work of the National Foundation for Educational Research, that the need for educational research ceases at the school-leaving age if not at the 11+ examination [41].

The pressing need for buildings and equipment to enable the technical institutions to fulfil their aims is now well known; progress has certainly been made in recent years, and the amount of building now under construction is greater than at any other single period (p. 550). The prospective increase under Circular 283 (December, 1954) is certainly encouraging. Though it is gratifying to make good former decades of delay, it is quite another thing to foresee and prepare for the next decade or two ahead. Unless there is a greater belief in education, there may soon result a complacent relaxation when the most urgent and obvious technological requirements have been met. Unless we are vigilant we may see the other educational needs of students in broader courses and in social activities, and the fulfilment of their education in adult education, quietly set aside and unprovided for. Technical education is not an end in itself, but must take its place in the wider continuum of education as a whole leading from the child to the mature citizen, and these wider interests and activities are an integral part of its work in this direction.

In conclusion, we turn from the 'hardware' of buildings and equipment to the educational ideas which they embody and serve. We have to provide education in and for a technological society, a society in process of rapid change and oppressed by a recurrent sense of crisis. To sensitive but robust minds this sense of crisis is the outstanding challenge of our times, which has been expressed and taken up in such pre-eminent works as *The Future in Education* and *Education for a World Adrift* by Sir Richard Livingstone, *Civilisation on Trial*, by Professor A. J. Toynbee, Sir Walter Moberly's *The Crisis in the University* [42], and Dr. R. Hutchins' *The University of Utopia*. It has brought many other and challenging utterances as by Guy Hunter [43], and also by Dr. Robert Hutchins as in the following passage [44]:

> Other civilisations were destroyed by barbarians from without. We breed our own. The new barbarians have, many of them, very sharp wits. They have marvellous technical skill. They may even be very learned in specific disciplines. But they are barbarians because they are uncultivated. Culture is not mere aesthetic ornamentation on the one hand or the grasp of a narrow field of specialisation. Culture is the mastery of a system of ideas. . . . We cannot live on the human level without ideas. Upon them depends what we do. Culture, in the sense of the mastery of a system of ideas, is what saves human life from being mere disaster, what makes it something above meaningless tragedy or inward disgrace. The new barbarians are those who have had no will or no opportunity to develop a system of ideas because they have

confined themselves, or been confined, to small fractions of human interest and experience. They have no conception of the world or the destiny of man.

It is not only in the volume of work and range of facilities that a change is required, but also in the kind of education which is provided. It has been said that the virtue of a classical education is that 'it enables one to ignore those rewards in this life which it renders one incapable of earning' [45]. To this in justice we should at least add a technological counterpart which can produce only a wry smile; a technological training enables one to gain those rewards in this life which it renders one incapable of enjoying. And, further, as a commentary on this atomic age, technology enables mankind to create that high standard of living which it renders increasingly improbable of continued existence [45*a*]. In short, vastly important though it is, technology is not enough; it is a means not an end, and the great human issues and problems remain.

Man's conception of the world and of his own destiny has been profoundly affected by the impact of scientific thought in the last century, and will continue to be affected by its progress and discoveries. But it will not be confined by them nor made of no consequence, and the challenge to bring meaning into this conception and significance into this destiny, remains for us also in technical education. We should note what the late Sir Fred Clarke had to say on this:

> Finally . . . a word must be added concerning the significance of 'technical' education. It has been argued that vocations are integral to culture to a degree that has been insufficiently appreciated. Advancing technology is rapidly changing the nature of the vocational basis upon which, in the last resort, the cultural structure rests. With such changes there must also come changes in cultural expressions. Who will be the heralds and first delineators of the new forms? One may say of their art, as Shelley said of poetry, that it is 'the image of the gigantic shadow which futurity casts upon the present.'
>
> But their vision is not easily and quickly caught by the common man. Yet he will need something of it if he is to play his part in the effort to maintain a free society. May not teachers and able young students in technical colleges discharge an important function here? Properly stimulated and taught to appreciate the wider social and cultural significance of what they are engaged upon, they may be able to offer premonitions of the future that the ordinary man can grasp. They are closer than most of us to one of the great springs of change, and if they work in a large enough field of discourse, their work and vision may have a prophetic quality that should be understood and communicated [46].

To a rare insight the late Sir Fred Clarke added an expression of a robust faith when he wrote, 'Happily there are signs that the technical colleges are understanding this and taking appropriate action.' How much this is justified, and how far there is still to go in fulfilling both our special purposes and wider aims, may perhaps be discerned from these pages. Certainly those with high ideals engaged in technical education need lack no worthwhile satisfactions in meeting 'the challenge of change' in the years that lie ahead.

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APPENDIX

TECHNICAL INSTITUTIONS

These are divided into four main groups:

Polytechnics, Technical Colleges, Colleges of Technology, Colleges of Further Education; many of these include Commerce Departments and Schools of Art.

Colleges of Commerce and other Commerce Institutions.

Colleges and Schools of Art.

National Colleges.

NOTE

i. Membership lists have been checked up to April, 1955, and those in Association of Technical Institutions are indicated by † (p. 163).
Association of Principals of Technical Institutions are indicated by * (p. 164).

ii. Where possible, the figures given are the 1952–3 enrolments of senior students. The total enrolments (in bold) include part-time day students attending evening classes and are therefore greater than the net number of individual students (p. 205).

iii. Where the technical college has a School of Art, a separate figure is given for this, and the resulting gross total of enrolments of senior students; in most if not all such cases the School of Art is an integral part of the administration of the whole college.

iv. Where a Secondary Technical School is housed on the premises of the technical institution the figure is given separately and not included in the gross total. Enquiry must be made to the institution concerned to determine whether the school is an integral part of its administration or is simply accommodated there (p. 96).

†*ABERDEEN, Robert Gordon's Technical College. 2,070 (F.T. 781; P.T-day 156; Evg. 1,133).

*ABERSYCHAN, Mining and Technical Institute, Pontypool, Mon. 872 (F.T. —; P.T-day 322; Evg. 550). S.T.S. 196.

†*ACCRINGTON, College of Further Education. 2,287 (F.T. —; P.T-day 422; Evg. 1,865). S.T.S. 219.

†*ACTON, Technical College, High Street, W.3. 5,614 (F.T. 501; P.T-day 1,712; Evg. 3,401). S.T.S. 375.

†AMMANFORD, Technical College. 812 (F.T. —; P.T-day 374; Evg. 438)

†*ASHFORD, Technical Institute, Elwick Road. 508 (F.T. —: P.T-day 128; Evg. 380).

†*ASHINGTON, County College and Mining School, Park Road. 2,159 (F.T. —; P.T-day 987; Evg. 1,172).

†*ASHTON-UNDER-LYNE, College of Further Education, Old Street, 934 (F.T. 16; P.T-day 349; Evg. 569). S.T.S. 186.

†*BARNSLEY, Mining and Technical College, Church Street. 7,173 (F.T. 109; P.T-day 3,378; Evg. 3,686). S.T.S. 432.

†*BARROW-IN-FURNESS, Technical College, Abbey Road. 2,505 (F.T. —; P.T-day 860; Evg. 1,645). S.T.S. 266.

*BASINGSTOKE, Technical College. 796 (F.T. —; P.T-day 379; Evg. 417).

†*BATH, Technical College, Lower Borough Walls. 4,107 (F.T. 142; P.T-day 1,818; Evg. 2,147). S.T.S. 471.

†*BEDFORD, North Bedfordshire College of Further Education, Holme Street. 2,887 (F.T. 169; P.T-day 964; Evg. 1,754).

†*BELFAST, College of Technology. 9,134 (F.T. 906; P.T-day 1,259; Evg. 6,969).

†BILSTON, College of Further Education. 1,928 (F.T. —; P.T-day 666; Evg. 1,262).

†*BIRKENHEAD, Technical College, Borough Road. 1,968 (F.T. 33; P.T-day 616; Evg. 1,319). S.T.S. 47.

†*BIRMINGHAM, Aston Technical College. 4,540 (F.T. 43; P.T-day 2,147; Evg. 2,350).

*BIRMINGHAM, Brooklyn Farm Technical College (commenced September, 1953).

†*BIRMINGHAM, College of Technology. 7,437 (F.T. 453; P.T-day 4,634; Evg. 6,245).

*BIRMINGHAM, Garretts Green Technical College (commenced September, 1953).

†*BIRMINGHAM, Handsworth Technical College. 2,119 (F.T. —; P.T-day 837; Evg. 282; S.T.S. 616).

†*BLACKBURN, Municipal Technical and School of Art. 5,095 (F.T. 100; P.T-day 1,754; Evg. 3,241). School of Art 537 (p. 601). Total 5,632.

†*BLACKPOOL, Technical College and School of Art, Palatine Road. 6,133 (F.T. 524; P.T-day 2,087; Evg. 3,522). School of Art 760 (p. 601). Total 6,893. S.T.S. 648.

†*BOLTON, Technical College. 7,786 (F.T. 153; P.T-day 2,198; Evg. 5,435). S.T.S. 400.

†*BOOTLE, Municipal Technical College. 1,050 (F.T. —; P.T-day 311; Evg. 739). S.T.S. 218.

†*BOURNEMOUTH, Municipal College of Technology and Commerce. 5,071 (F.T. 427; P.T-day 1,548; Evg. 3,096). S.T.S. 75.

†BOURNVILLE, Day Continuation College. (P.T-day 2,222.)

†*BRADFORD, Technical College. 5,065 (F.T. 496; P.T-day 1,208; Evg. 3,361).

*BRAINTREE, Technical and Arts Institute, East Street. 1,259 (F.T. 44; P.T-day 402; Evg. 813).

†*BRIDGEND, Technical College, Glamorganshire. 3,618 (F.T. 77; P.T-day 1,413; Evg. 2,128). S.T.S. 224.

†*BRIGHTON, Technical College, Richmond Terrace. 5,453 (F.T. 841; P.T-day 1,138; Evg. 3,474).

†*BRISTOL, College of Technology. 6,894 (F.T. 207; P.T-day 2,871; Evg. 3,816).

†BROMLEY, Technical Institute. 1,272 (F.T. 114; P.T-day 25; Evg. 1,133).

†*BURNLEY, Municipal College, Ormerod Road. 5,326 (F.T. 128; P.T-day 2,113; Evg. 3,085).

†*BURTON-UPON-TRENT, Technical College, Union Street. 2,864 (F.T. 103; P.T-day 827; Evg. 1,934).

†*BURY, Technical College, Market Street. 2,395 (F.T. —; P.T-day 710; Evg. 1,685). School of Art 283 (p. 601). Total 2,678. S.T.S. 141.

*BURY ST. EDMUNDS Technical Institute. 868 (F.T. —; P.T-day 266; Evg. 602).

†*CAMBORNE, Cornwall Technical College, Trevenson, Redruth. 2,866 (F.T. 478; P.T-day 1,224; Evg. 1,164). School of Art 199 (p. 601). Total 2,872.

†*CAMBRIDGE, Cambridgeshire Technical College and School of Art. 5,748 (F.T. 250; P.T-day 2,667; Evg. 2,831). School of Art 633 (p. 601). Total 6,381. S.T.S. 148.

*CAMBUSLANG, School of Building, Lanarkshire.

†*CANNOCK, Cannock Chase Mining and Technical College, Staff. 1.995 (F.T. —; P.T-day 1,056; Evg. 939). S.T.S. 138.

†*CANTERBURY, Technical College, Longport Street. 2,590 (F.T. 21; P.T-day 1,133; Evg. 1,436). S.T.S. 468.

†*CARDIFF, College of Technology and Commerce. 6,941 (F.T. 743; P.T-day 1,310; Evg. 4,888).

†*CARLISLE, Technical College, Victoria Place. 1,532 (F.T. 19; P.T-day 311; Evg. 1,202). S.T.S. 48.

†CARMARTHEN, Pibwrlwyd Technical College. 1,710 (F.T. 47; P.T-day 509; Evg. 1,154).

†*CASTLEFORD, Whitwood Mining and Technical College, Yorks. 2,563 (F.T. 13; P.T-day 1,161; Evg. 1,389). S.T.S. 304.

†*CHELMSFORD, Mid-Essex Technical College and School of Art. 4,303 (F.T. 147; P.T-day 1,445; Evg. 2,711). School of Art 257 (p. 601). Total 4,560. S.T.S. 537.

†*CHELTENHAM, North Gloucestershire Technical College, Lansdown Road. 3,789 (F.T. 323; P.T-day 1,333; Evg. 2,133). S.T.S. 469.

†*CHESTER, College of Further Education, Watergate Street. 2,808 (F.T. 117; P.T-day 807; Evg. 1,884).

†*CHESTERFIELD, College of Technology, Infirmary Road. 5,216 (F.T. 132; P.T-day 2,215; Evg. 2,869).

†*CHISWICK, Polytechnic, Bath Road, W.4. 3,241 (F.T. 326; P.T-day 837; Evg. 2,078). S.T.S. 141.

*CINDERFORD, Forest of Dean Mining and Technical College. 1,021. (F.T. 30; P.T-day 252; Evg. 739).

†*COALVILLE, Mining and Technical College, Tithebarn Street. 1,868 (F.T. —; P.T-day 902; Evg. 966).

†*COLCHESTER, North-East Essex Technical College and School of Art. 2,884 (F.T. 97; P.T-day 649; Evg. 2,138). School of Art 261 (p. 601). Total 3,145. S.T.S. 494.

*CONNAH'S QUAY, Flintshire Technical College. 1,349 (F.T. 27; P.T-day 688; Evg. 634).

†*COVENTRY, Technical College. 11,115 (F.T. 74; P.T-day 5,557; Evg. 5,484). S.T.S. 458.

*CREWE, Technical College, Hightown. 1,641 (F.T. —; P.T-day 499; Evg. 1,142).

†*CROYDON, Croydon Polytechnic, Scarbrook Road. 6,155 (F.T. 187; P.T-day 1,855; Evg. 4,113). S.T.S. 269.

†*CRUMLIN, The Technical College of Monmouthshire, Mon. 2,569 (F.T. 160; P.T-day 1,035; Evg. 1,374).

†*DAGENHAM, South-East Essex Technical College and School of Art, Longbridge Road. 7,949 (F.T. 244; P.T-day 1,613; Evg. 6,092). School of Art 1,059 (p. 601). Total 9,008.

†*DARLINGTON, Technical College, Northgate. 3,892 (F.T. 47; P.T-day 1,071; Evg. 2,774). S.T.S. 191.

†*DARTFORD, Technical College, Lowfield Street. 2,536 (F.T. 149; P.T-day 628; Evg. 1,759). S.T.S. 307.

†DARWEN, Technical School. 914 (F.T. —; P.T-day —; Evg. 914). S.T.S. 253.

†*DERBY, Technical College, Normanton Road. 10,583 (F.T. 397; P.T-day 3,438; Evg. 6,748).

†*DEWSBURY, Dewsbury and Batley Technical and Art College, Halifax Road. 3,160 (F.T. 76; P.T-day 947; Evg. 2,137). School of Art 804 (p. 601). Total 3,964. S.T.S. 328.

†*DINNINGTON, Chelmsford Mining and Technical Institute, Yorks. 1,046 (F.T. —; P.T-day 701; Evg. 345). S.T.S. 342.

†*DONCASTER, Technical College, St. George Gate. 6,660 (F.T. 116; P.T-day 2,053; Evg. 4,491). S.T.S. 381.

†*DOVER, Technical College. 1,521 (F.T. 20; P.T-day 274; Evg. 1,227).

†*DUDLEY, Dudley and Staffordshire Technical College. 5,024 (F.T. 24; P.T-day 1,573; Evg. 3,427). School of Art 228 (p. 601). Total 5,245. S.T.S. 249.

†*DUNDEE, Technical College. 1,882 (F.T. 225; P.T-day 348; Evg. 1,309.

†DUNDEE, Trades College.

†*EALING, Technical College, Warwick Road, W.5. 3,466 (F.T. 101; P.T-day 423; Evg. 2,942). School of Art 1,145 (p. 602). Total 4,087. S.T.S. 218.

†*EASTBOURNE, Technical Institute, St. Anne's Road. 1,575 (F.T. 10; P.T-day 440; Evg. 1,125). S.T.S. 120.

†*EAST HAM, Technical College, E.6. 5,381 (F.T. 52; P.T-day 1,464; Evg. 3,865). S.T.S. 132.

†*EDINBURGH, Heriot Watt College, Chambers Street, 1. 4,041 (F.T. 425; P.T-day 724; Evg. 2,892).

†*ENFIELD, Technical College, Queensway. 5,674 (F.T. 120; P.T-day 1,949; Evg. 3,605). S.T.S. 343.

†*ERITH, Technical College. 1,471 (F.T. —; P.T-day 439; Evg. 1,032). S.T.S. 245.

†*EWELL, Technical College. 1,732 (F.T. —; P.T-day 543; Evg. 1,189).

†*EXETER, Central Technical College, Belmont Park. 2,471 (F.T. 71; P.T-day 570; Evg. 1,830).

†*FARNBOROUGH, Royal Aircraft Establishment Technical College, Hants. 1,046 (F.T. —; P.T-day 21; Evg. 1,025).

†*FOLKESTONE, Technical College, The Grange, Shorncliffe Road. 1,725 (F.T. 306; P.T-day 228; Evg. 1,191).

†*GAINSBOROUGH, County Technical College, Morton Terrace. 1,264 (F.T. 39; P.T-day 441; Evg. 784).

†*GATESHEAD, Technical College, Durnham Road, Gateshead 9. 2,559 (F.T. 184; P.T-day 1,111; Evg. 1,264).

†*GILLINGHAM, Medway Technical College, Kent. 5,280 (F.T. 157; P.T-day 1,382; Evg. 3,741). S.T.S. 1,197.

†*GLASGOW, Royal Technical College, George Street, C.1. 5,253 (F.T. 1,305; P.T-day 1,206; Evg. 2,742).

†*GLOUCESTER, Technical College, Brunswick Road. 3,575 (F.T. 74; P.T-day 1,318; Evg. 2,183).

†*GRANTHAM, College for Further Education, Avenue Road. 1,337 (F.T. 22; P.T-day 559; Evg. 756).

†*GRAVESEND, Technical College. 2,565 (F.T. 37; P.T-day 764; Evg. 1,764). S.T.S. 614.

†*GRIMSBY, College of Further Education. 2,628 (F.T. 124; P.T-day 347; Evg. 2,157). School of Art 467 (p. 602). Total 3,095.

†*GUILDFORD, County Technical College, Stoke Park. 4,043 (F.T. 353; P.T-day 1,673; Evg. 2,017). S.T.S. 218.

†*HALESOWEN, College of Further Education. 1,198 (F.T. —; P.T-day 192; Evg. 1,006). S.T.S. 204.

†*HALIFAX, Municipal Technical College, Hopwood Lane. 4,308 (F.T. 70; P.T-day 1,328; Evg. 2,910). School of Art 428 (p. 602). Total 4,736. S.T.S. 288.

†HARROGATE, Technical Institute. 1,589 (F.T. —; P.T-day 165; Evg. 1,424). S.T.S. 293.

†*HARROW, Technical College and School of Art, Station Road. 4,991 (F.T. 28; P.T-day 1,143; Evg. 3,820). School of Art 1,208 (p. 602). Total 6,199.

†*HATFIELD, Technical College, Roe Green. 2,524 (F.T. 55; P.T-day 906; Evg. 1,563).

†HEMSWORTH, Mining and Technical College. 917 (F.T. —; P.T-day 620; Evg. 297).

†*HENDON, Technical College, The Burroughs, N.W.4. 4,879 (F.T. 494; P.T-day 797; Evg. 3,588). S.T.S. 292.

*HEREFORD, College of Further Education. 1,798 (F.T. 90; P.T-day 559; Evg. 1,149).

†*HIGH WYCOMBE, College of Further Education, Easton Street. 1,751 (F.T. 14; P.T-day 261; Evg. 1,476). S.T.S. 360.

†*HINCKLEY, College of Further Education. 1,593 (F.T. 66; P.T-day 471; Evg. 1,056).

†HORWICH, Technical College. 483 (F.T. —; P.T-day 81; Evg. 402). S.T.S. 103.

†*HUDDERSFIELD, Technical College. 7,905 (F.T. 411; P.T-day 1,986; Evg. 5,508). School of Art 872 (p. 602). Total 8,777.

†*IPSWICH, School of Technology, Tower Ramparts. 2,563 (F.T. 31; P.T-day 1,174; Evg. 1,358).

†*ISLEWORTH, Spring Grove Polytechnic, London Road, Middlesex. 2,853 (F.T. 47; P.T-day 714; Evg. 2,092).

†*KEIGHLEY, Technical College, Lord Street. 3,068 (F.T. 6; P.T-day 549; Evg. 2,513). S.T.S. 225.

†*KILBURN, Kilburn Polytechnic, Priory Park Road, N.W.6. 1,932 (F.T. 94; P.T-day 124; Evg. 1,714). S.T.S. 523.

†KING'S LYNN Technical College. 1,946 (P.T. 123; P.T-day 356; Evg. 1,467).

†*KINGSTON-UPON-HULL, Municipal Technical College. 4,956 (F.T. 419; P.T-day 1,232; Evg. 3,305). S.T.S. 116.

†*KINGSTON-UPON-THAMES, Technical College, Kingston Hall Road. 4,121 (F.T. 588; P.T-day 1,092; Evg. 2,441). S.T.S. 303.

†*LANCASTER, Lancaster and Morecambe College of Further Education. 3,270 (F.T. 48; P.T-day 840; Evg. 2,382). S.T.S. 161.

*LEAMINGTON SPA, Mid-Warwickshire College of Further Education. 583 (F.T. 62; P.T-day 135; Evg. 386).

†*LEEDS, College of Technology, Cookridge Street. 8,479 (F.T. 234; P.T-day 2,519; Evg. 5,726).

†*LEICESTER, College of Technology and Commerce. 6,979 (F.T. 720; P.T-day 2,237; Evg. 4,022).

†*LEIGH, Technical College. 3,228 (F.T. 22; P.T-day 1,572; Evg. 1,634). S.T.S. 116.

†LETCHWORTH, North Herts. Technical College. 2,168 (F.T. 27; P.T-day 867; Evg. 1,274).

†*LINCOLN, Technical College. 3,301 (F.T. 153; P.T-day 1,148; Evg. 2,000).

†*LIVERPOOL, College of Building, Clarence Street. 2,234 (F.T. 100; P.T-day 824; Evg. 1,310).

†*LIVERPOOL, College of Technology, Byrom Street. 3,714 (F.T. 383; P.T-day 1,487; Evg. 1,844).

*LIVERPOOL, Riversdale Technical College. 1,993 (F.T. 41; P.T-day 970; Evg. 982).

†*LLANELLY, Technical College, Alban Road. 1,710 (F.T. 47; P.T-day 509; Evg. 1,154).

*LLWYNPIA, Rhondda Technical Institute. 1,926 (F.T. 46; P.T-day 897; Evg. 983).

†*LONDON, Barrett Street Technical College, Oxford Street, W.1. 2,086 (F.T. 521; P.T-day 56; Evg. 1,509).

†*LONDON, Battersea Polytechnic, Battersea Park Road, Battersea, S.W.11. 3,233 (F.T. 900; P.T-day 330; Evg. 2,003).

†*LONDON, Bloomsbury Technical School for Women, Queen Square, W.C.1. 299 (F.T. 8; P.T-day 4; Evg. 287). S.T.S. 164.

†*LONDON, Borough Polytechnic, Borough Road, S.E.1. 7,167 (F.T. 366; P.T-day 2,556; Evg. 4,245). School of Art 531 (p. 602). Total 7,698.

†*LONDON, Brixton School of Building, S.W.4. 4,119 (F.T. 251; P.T-day 1,103; Evg. 2,765). S.T.S. 333.

†LONDON, Brixton Day Continuation School. 1,202 (F.T. 278; P.T-day 924; Evg. —).

†*LONDON, Chelsea Polytechnic, Manresa Road, Chelsea, S.W.3. 2,623 (F.T. 618; P.T-day 241; Evg. 1,764). School of Art 644 (p. 602). Total 3,267.

†*LONDON, City Literary Institute, Stukeley Street, W.C.2. 8,960 (F.T. —; P.T-day 502; Evg. 8,458).

†LONDON, College for the Distributive Trades, 107 Charing Cross Road, W.C.2. 3,774 (F.T. 74; P.T-day 1,502; Evg. 2,198).

†*LONDON, Cordwainer's Technical College, Hackney, E.8. 507 (F.T. 59; P.T-day 178; Evg. 270).

†LONDON, Hackney Technical College, E.8. 1,443 (F.T. —; P.T-day 457; Evg. 986).

†*LONDON, Hammersmith School of Building and Arts and Crafts, Shepherds Bush, W.12. 2,092 (F.T. 177; P.T-day 478; Evg. 1,437).

†*LONDON, King Edward VII Nautical College, 680 Commercial Road, E.14. 330 (F.T. 273; P.T-day —; Evg. 57).

†*LONDON, Northampton Polytechnic, 280 St. John's Street, E.C.1. 6,037 (F.T. 407; P.T-day 1,689; Evg. 3,941).

†*LONDON, Northern Polytechnic, Holloway Road, N.7. 4,639 (F.T. 683; P.T-day 804; Evg. 3,152).

†*LONDON, North-western Polytechnic, N.W.5. 4,112 (F.T. 230; P.T-day 892; Evg. 2,990). S.T.S. 220.

†*LONDON, Norwood Technical College, Knights Hill, West Norwood. S.E. 27. **1,973** (F.T. 267; P.T-day 286; Evg. 1,420).

†*LONDON, Paddington Technical College, Saltram Crescent, W.9. **2,768** (F.T. 18; P.T-day 1,064; Evg. 1,686). S.T.S. 233.

†*LONDON, The Polytechnic, Regent Street, W.1. **13,093** (F.T. 1,589; P.T-day 1,102; Evg. 10,402). School of Art **863** (p. 602). Total **13,956** (also members, see p. 63).

†*LONDON, Poplar Technical College, Poplar High Street, E.14. **1,784** (F.T. 163; P.T-day 616; Evg. 1,005). S.T.S. 193.

†*LONDON, London School of Printing and Graphic Arts, Back Hill, Clerkenwell Road, E.C.1. **7,166** (F.T. 224; P.T-day 3,510; Evg. 3,432).

†*LONDON, Shoreditch College for the Garment Trades, Curtain Road, E.C.2. **977** (F.T. 25; P.T-day 69; Evg. 883). S.T.S. 238.

†*LONDON, Sir John Cass College, Jewry, Aldgate, E.C.3. **2,478** (F.T. 394; P.T-day 467; Evg. 1,617). School of Art **269** (p. 602). Total **2,747.**

†*LONDON, South-East London Technical College, Lewisham Way, S.E.4. **5,950** (F.T. 143; P.T-day 2,024; Evg. 3,783). S.T.S. 598.

†LONDON, Technical College for Furnishing Trades, Pitfield Street, N.1. **637** (F.T. 25; P.T-day 347; Evg. 265).

†*LONDON, Wandsworth Technical College, Wandsworth High Street, S.W.18. **3,283** (F.T. 18; P.T-day 1,163; Evg. 2,102). S.T.S. 437.

†LONDON, Westminster Technical College, Vincent Square, S.W.1. **2,303** (F.T. 252; P.T-day 556; Evg. 1,495).

†*LONDON, Woolwich Polytechnic, Thomas Street, Woolwich, S.E.18. **5,374** (F.T. 336; P.T-day 1,539; Evg. 3,499). School of Art **269** (p. 602). Total **5,643.** S.T.S. 628.

†*LOUGHBOROUGH, College of Further Education. **2,160** (F.T. 100; P.T-day 612; Evg. 1,448).

†*LOUGHBOROUGH, College of Technology. **799** (F.T. 799; P.T-day —; Evg. —).

*LOWESTOFT, Technical Institute. **1343** (F.T. 87; P.T-day 357; Evg. 899).

†*LUTON, Luton and South Beds. College of Further Education, Park Square. **7,510** (F.T. —; P.T-day 3,118; Evg. 4,392). School of Art **257** (p. 602). Total **7,767.** S.T.S. 571.

†*MAIDSTONE, Technical College, Tonbridge Road, Kent. **2,871** (F.T. 71; P.T-day 856; Evg. 1,944). S.T.S. 613.

†*MALVERN, Ministry of Supply, College of Electronics.

†*MANCHESTER, Domestic and Trades College, 289 Wilmslow Road, Manchester 14. **3,568** (F.T. 142; P.T-day 1,317; Evg. 2,771).

†*MANCHESTER, College of Technology, Manchester 1. **7,458** (F.T. 897; P.T-day 1,491; Evg. 5,169).

†*MANCHESTER, Newton Heath Technical College, Newton Heath, Manchester 10. **1,716** (F.T. —; P.T-day 1,068; Evg. 648). S.T.S. 153.

†*MANCHESTER, Openshaw Technical College, Gorton Road, Manchester 12. **3,690** (F.T. 76; P.T-day 1,998; Evg. 1,616). S.T.S. 225.

†*MANSFIELD, Technical College, Notts. **3,885** (F.T. 70; P.T-day 1,881; Evg. 1,934).

†*MELTON MOWBRAY, Melton Mowbray and District College of Further Education. **1,281** (F.T. 62; P.T-day 286; Evg. 933).

†*MEXBOROUGH, Scholfield Technical College, Yorks. 2,132 (F.T. —; P.T-day 767; Evg. 1,365). S.T.S. 322.

†*MIDDLESBROUGH, Constantine Technical College. 5,683 (F.T. 399; P.T-day 1,469; Evg. 3,815). School of Art 608 (p. 602). Total 6,145. S.T.S. 348.

†*NEATH, Technical College. 2,625 (F.T. 50; P.T-day 1,056; Evg. 1,519. S.T.S. 275.

†*NELSON, College of Further Education, Market Street, Lancs. 1,230 (F.T. —; P.T-day 360; Evg. 870). School of Art 1,052 (p. 602). Total 2,282.

†*NEWARK, County Technical College. 1,124 (F.T. —; P.T-day 296; Evg. 828). S.T.S. 172.

*NEWBURY, South Berkshire College of Further Education. 2,243 (F.T. 47; P.T-day 464; Evg. 1,732).

†*NEWCASTLE-UPON-TYNE, Rutherford Technical College. 6,079 (F.T. 109; P.T-day 1,993; Evg. 3,977).

†*NEWPORT, Technical College, Mon. 3,548 (F.T. 24; P.T-day 1,203; Evg. 2,321). School of Art 1,146 (p. 602). Total 4,694. S.T.S. 272;

†*NEWTON-LE-WILLOWS, College of Further Education. 1,791 (F.T. —; P.T-day 365; Evg. 1,426). S.T.S. 98.

†*NORTHAMPTON, College of Technology, St. Georges Avenue. 4,425 (F.T. 281; P.T-day 1,426; Evg. 2,718). S.T.S. 399.

*NORTHWICH, Verdin Technical College. 1,013 (F.T. 53; P.T-day 473; Evg. 487). School of Art 303 (p. 602). Total 1,316.

†*NORWICH, City College and Art School, Ipswich Road. 4,496 (F.T. 320; P.T-day 2,490; Evg. 1,922). School of Art 511 (p. 602). Total 5,007. S.T.S. 334.

†*NOTTINGHAM, Nottingham and District Technical College, Shakespeare Street. 8,160 (F.T. 128; P.T-day 3,287; Evg. 4,745).

†NOTTINGHAM, People's College of Further Education. 3,116 (F.T. 41; P.T-day 1,096; Evg. 1,979).

†*NUNEATON, Technical College and School of Art. 2,157 (F.T. 22; P.T-day 1,421; Evg. 714). School of Art 751 (p. 602). Total 2,908.

†*OAKENGATES, Walker Technical College, Hartshill. 1,781 (F.T. 41; P.T-day 794; Evg. 946). S.T.S. 220.

†OLDBURY, College of Further Education. 969 (F.T. —; P.T-day 296; Evg. 673). S.T.S. 141.

†*OLDHAM, Municipal College, Ascroft Street. 3,702 (F.T. —; P.T-day 1,250; Evg. 2,452). S.T.S. 281.

†OSWESTRY, Technical Institute. 689 (F.T. 52; P.T-day 145; Evg. 492). S.T.S. 132.

†*OXFORD, College of Technology, Art and Commerce, Cowley Road. 4,865 (F.T. 178; P.T-day 1,947; Evg. 2,740). School of Art, 1,051 (p. 602). Total 5,916. S.T.S. 273.

†PAISLEY, Technical College, George Street. 1,969 (F.T. 112; P.T-day 867; Evg. 990).

†PETERBOROUGH, Technical College. 3,181 (F.T. 20; P.T-day 1,095; Evg. 2,066).

†*PLYMOUTH, Plymouth and Devonport Technical College, Tavistock Road. 4,146 (F.T. 415; P.T-day 1,372; Evg. 2,359).

†*PORTSMOUTH, City of Portsmouth College of Technology. 6,604 (F.T. 385; P.T-day 1,885; Evg. 4,334).

†PORT TALBOT, College of Further Education. 901 (F.T. 25; P.T-day 244; Evg. 632).

†*PRESTON, Harris Institute, Corporation Street. 4,275 (F.T. 94; P.T-day 1,274; Evg. 2,907). School of Art 807 (p. 602). Total 5,082. S.T.S. 243.

†PUDSEY, Technical Institute, Richardshare Lane. 1,502 (F.T. —; P.T-day 89; Evg. 1,413).

†*RADCLIFFE, Technical College, Whittaker Street. 1,427 (F.T. —; P.T-day 260; Evg. 1,167). S.T.S. 157.

†*RAMSGATE, Thanet Technical College, High Street. 1,676 (F.T. 132; P.T-day 419; Evg. 1,125).

†*READING, Technical College, London Road. 3,750 (F.T. 8; P.T-day 1,070; Evg. 2,672). S.T.S. 197.

†*ROCHDALE, Technical College, Nelson Street. 2,130 (F.T. —; P.T-day 330; Evg. 1,800). S.T.S. 665.

†*ROTHERHAM, College of Technology. 5,919 (F.T. 240; P.T-day 2,299; Evg. 3,380).

†*RUGBY, College of Technology and Arts, Eastlands. 5,160 (F.T. 13; P.T-day 2,536; Evg. 2,611). School of Art 464 (p. 602). Total 5,624. S.T.S. 96.

†*ST. HELENS, Technical College. 6,025 (F.T. —; P.T-day 3,030; Evg. 2,995). School of Art 654 (p. 600). Total 6,679.

†*SALFORD, Royal Technical College, Peel Park, Salford 5. 8,291 (F.T. 386; P.T-day 3,725; Evg. 4,180). School of Art 437 (p. 602). Total 8,728. S.T.S. 241 (leaving in 1955).

*SALISBURY, Salisbury and South Wiltshire College of Further Education. 2,383 (F.T. 179; P.T-day 476; Evg. 1,728).

†*SCARBOROUGH, Technical Institute, Westbourne Grove. 2,022 (F.T. 68; P.T-day 351; Evg. 1,603). School of Art 223 (p. 602). Total 2,245. S.T.S. 81.

†*SCUNTHORPE, North Lindsey Technical College. 2,257 (F.T. 20; P.T-day 762; Evg. 1,475). S.T.S. 588.

†SELBY, Art School and Technical Institute. 500 (F.T. —; P.T-day 104; Evg. 396). S.T.S. 179.

†SHEERNESS, Technical Institute. 393 (F.T. 15; P.T-day 62; Evg. 316). S.T.S. 160.

†*SHEFFIELD, College of Commerce and Technology, Holly Street. 8,033 (F.T. 162; P.T-day 2,161; Evg. 5,710). S.T.S. 615.

†*SHIPLEY, Technical Institute, Exhibition Road. 1,081 (F.T. —; P.T-day 174; Evg. 907).

†*SHREWSBURY, Technical College. 3,229 (F.T. 191; P.T-day 1,181; Evg. 1,857). School of Art 467 (p. 602). Total 3,696. S.T.S. 417.

†*SLOUGH, College of Further Education, William Street. 4,078 (F.T. 47; P.T-day 1,106; Evg. 2,925). S.T.S. 352.

†*SMETHWICK, Chance Technical College. 3,784 (F.T. 97; P.T-day 1,414; Evg. 2,273).

†*SOUTHALL, Technical College, Beaconsfield Road, Middlesex. 5,527 (F.T. —; P.T-day 1,669; Evg. 3,858). S.T.S. 392.

*SOUTHAMPTON, School of Navigation. (F.T. 230.)

†SOUTHAMPTON, Technical College. 4,640 (F.T. 139; P.T-day 2,425; Evg. 2,076). S.T.S. 186.

†*SOUTHEND-ON-SEA, Municipal College. 4,569 (F.T. 494; P.T-day 741; Evg. 3,334). School of Art 933 (p. 602). Total 5,524. S.T.S. 109.

†*SOUTHPORT, Technical College. 2,964 (F.T. 171; P.T-day 744; Evg. 2,049). S.T.S. 211.

†*SOUTH SHIELDS, Marine and Technical College, Ocean Road. 3,233 (F.T. 558; P.T-day 833; Evg. 1,842). S.T.S. 199.

†*STAFFORD, County Technical College, Cherry Street. 3,676 (F.T. 52; P.T-day 1,487; Evg. 2,137).

†*STOCKPORT, College for Further Education, Wellington Road. 5,966 (F.T. 105; P.T-day 2,246; Evg. 3,615). School of Art 692 (p. 602). Total 6,558. S.T.S. 294.

*STOCKTON-ON-TEES, Technical College. 7,918 (F.T. 521; P.T-day 1,807; Evg. 5,590).

†*STOKE-ON-TRENT, North Staffordshire Technical College, Victoria Road. 8,551 (F.T. 195; P.T-day 4,133; Evg. 4,223). S.T.S. 173.

†*STRETFORD, Technical College, Lancs. 3,530 (F.T. 27; P.T-day 1,407; Evg. 2,096). S.T.S. 292.

†*STROUD, Stroud and District Technical College. 1,623 (F.T. 125; P.T-day 691; Evg. 807). S.T.S. 608.

†*SUNDERLAND, Technical College. 3,173 (F.T. 490; P.T-day 810; Evg. 1,873).

†*SWANSEA, Municipal Technical College, Mount Pleasant. 4,349 (F.T. 92; P.T-day 1,939; Evg. 2,318).

†*SWINDON, The College. 1,938 (F.T. 70; P.T-day 492; Evg. 1,376). School of Art 421 (p. 602). Total 2,359. S.T.S. 28.

†*TODMORDEN, Technical Institute, Rochdale Road. 686 (F.T. — P.T-day 152; Evg. 534).

*TORQUAY, South Devon Technical College, Teignmouth Road. 2,286 (F.T. 421; P.T-day 469; Evg. 1,396).

†*TOTTENHAM, Technical College, High Road, N.15. 3,224 (F.T. 210; P.T-day 770; Evg. 2,244). S.T.S. 378.

†*TREFOREST, Glamorgan Technical College, Llantwit Road, Glam. 2,172 (F.T. 144; P.T-day 1,095; Evg. 933).

†*TUNBRIDGE WELLS, West Kent Technical College, Monson Road, Royal Tunbridge Wells. 1,769 (F.T. —; P.T-day 459; Evg. 1,310). S.T.S. 149.

†*TWICKENHAM, Technical College and School of Art, Middlesex. 3,026 (F.T. —; P.T-day 736; Evg. 2,290). School of Art 1,111 (p. 602). Total 4,137. S.T.S. 372.

†*WAKEFIELD, Technical College, Bell Street. 4,032 (F.T. 90; P.T-day 1,343; Eng. 2,599). S.T.S. 152.

*WALSALL, Technical College, School Street, Wisemore. 2,926 (F.T. —; P.T-day 674; Evg. 2,252). S.T.S. 119.

†*WALTHAMSTOW, South-West Essex Technical College and School of Art. 6,537 (F.T. 656; P.T-day 946; Evg. 4,935). School of Art 743 (p. 602). Total 7,280. S.T.S. 1,015.

†*WARRINGTON, Technical College, Palmyra Square. 2,547 (F.T. 23; P.T-day 743; Evg. 1,781).

†*WATFORD, Technical College, Hempstead Road. 4,037 (F.T. 86; P.T-day 1,046; Evg. 2,905). School of Art 385 (p. 602). Total 4,422. S.T.S. 294.

†*WEDNESBURY, County Technical College. 2,100 (F.T. 16; P.T-day 813; Evg. 1,271). S.T.S. 121.

†*WELLINBOROUGH, Technical College, Church Street. 2,009 (F.T. 16; P.T-day 576; Evg. 1,417). S.T.S. 118.

†*WEST BROMWICH, Kenrick Technical College. 1,332 (F.T. —; P.T-day 284; Evg. 1,048).

†*WEST HAM, College of Technology. 2,852 (F.T. 209; P.T-day 1,263; Evg. 1,380).

†*WEST HARTLEPOOL, Technical College, Lauder Street. 2,292 (F.T. 10; P.T-day 828; Evg. 1,454). S.T.S. 443.

†*WEYBRIDGE, Brooklands County Technical College. **2,076** (F.T. 318; P.T-day 787; Evg. 971).

†WEYMOUTH, South Dorset Technical College. **1,197** (F.T. 84; P.T-day 539; Evg. 574). S.T.S. 224.

†WHITEHAVEN, Technical Institute. **754** (F.T. —; P.T-day 154; Evg. 600).

†*WIDNES, College of Further Education, Victoria Square. **2,110** (F.T. 29; P.T-day 583; Evg. 1,498). S.T.S. 60.

†*WIGAN, Wigan and District Mining and Technical College, Library Street. **3,685** (F.T. 272; P.T-day 1,157; Evg. 2,256). School of Art **365** (p. 602). Total **4,050**. S.T.S. 217.

†*WILLESDEN, Technical College, Denzil Road, N.W.10. **3,208** (F.T. 74; P.T-day 996; Evg. 2,138). School of Art **645** (p. 602). Total **3,853**. S.T.S. 480.

†*WIMBLEDON, Technical College, Gladstone Road, S.W. 19. **3,865** (F.T. 108; P.T-day 1,026; Evg. 2,731). S.T.S. 229.

†*WINDSOR, East Berkshire College of Further Education, Royal Albert Institute. **2,999** (F.T. 41; P.T-day 664; Evg. 2,294).

†*WOLVERHAMPTON, Wolverhampton and Staffordshire Technical College, Wulfruna Street. **5,152** (F.T. 89; P.T-day 1,209; Evg. 3,854).

†WOLVERTON, Technical College. **722** (F.T. —; P.T-day 130; Evg. 592). S.T.S. 209.

†*WORCESTER, Victoria Institute. **2,821** (F.T. 152; P.T-day 892; Evg. 1,777). School of Art **312** (p. 602). Total **3,133**. S.T.S. 177.

†*WORKINGTON, College of Further Education. **3,139** (F.T. 16; P.T-day 1,153; Evg. 1,970). S.T.S. 244.

†*WORKSOP, County Technical College. **1,418** (F.T. 29; PT-day 472; Evg. 917). S.T.S. 184.

†WORSLEY, Technical School, Nr. Manchester, Lancs. **2,036** (F.T. —; P.T-day 569; Evg. 1,467). S.T.S. 173.

†*WREXHAM, Denbighshire Technical College. **2,472** (F.T. 151; P.T-day 1,230; Evg. 1,091).

*YEOVIL, Technical College and School of Art, Kingston. **1,325**. (F.T. 41; P.T-day 478; Evg. 806). School of Art **242** (p. 602). Total **1,567**. S.T.S. 139.

†*YORK, Technical College, Clifford Street. **5,113** (F.T. 329; P.T-day 2,074; Evg. 2,710).

COLLEGES OF COMMERCE

†*BIRMINGHAM, City of Birmingham College of Commerce, Broad Street, 1. **4,845** (F.T. 168; P.T-day 606; Evg. 4,071).

†*BRISTOL, College of Commerce, St. George's Road. **4,172** (F.T. 183; P.T-day 1,030; Evg. 2,959).

*GLASGOW, Scottish College of Commerce. **3,802** (F.T. 712; P.T-day 56; Evg. 3,034).

†*KINGSTON-UPON-HULL, College of Commerce, Brunswick Avenue. **1,954** (F.T. 70; P.T-day 428; Evg. 1,456). S.T.S. 277.

†*LEEDS, College of Commerce, 43 Woodhouse Lane. **4,505** (F.T. 150; P.T-day 1,163; Evg. 3,192).

†*LIVERPOOL, City College of Commerce, Tithebarn Street, 2. **4,635** (F.T. 160; P.T-day 1,320; Evg. 3,155).

†*LONDON, Balham and Tooting College of Commerce, Tooting Broadway, S.W.17. 1,376 (F.T. 160; P.T-day 120; Evg. 1,096). S.T.S. 389.

†*LONDON, Catford College of Commerce, Plassy Road, Lewisham, S.E.6. 2,397 (F.T. —; P.T-day 174; Evg. 2,223).

†*LONDON, City of London College, Moorgate, E.C.2. 6,980 (F.T. 335; P.T-day 700; Evg. 5,945).

†LONDON, Fulham, West London College of Commerce. 3,666 (F.T. 141; P.T-day 68; Evg. 3,457).

†LONDON, Highbury College of Commerce, Laycock Street, N.1. 992 (F.T. —; P.T-day —; Evg. 992).

†*LONDON, Kennington College of Commerce and Law, Kennington Road, S.E.11. 2,481 (F.T. —; P.T-day 56; Evg. 2,425).

†LONDON, Princeton Street College of Languages and Commerce, Bedford Row, W.C.1. 5,030 (F.T. 146; P.T-day 670; Evg. 4,214).

†LONDON, Westminster College of Commerce, Erasmus Street, S.W.1. 5,643 (F.T. 30; P.T-day 581; Evg. 5,032).

†*MANCHESTER, College of Commerce, Princess Street. 3,085 (F.T. 119; P.T-day 659; Evg. 2,307). S.T.S. 133.

*†NEWCASTLE-UPON-TYNE, Municipal College of Commerce. 3,908 (F.T. 58; P.T-day 964; Evg. 2,886).

†*WEDNESBURY, County Commercial College. 1,593 (F.T. 121; P.T-day 366; Evg. 1,106). S.T.S. 304.

COLLEGES AND SCHOOLS OF ART

I. *Colleges and Schools of Art separate from Technical Colleges*

ACCRINGTON, School of Arts and Crafts, Lancs. 241 (F.T. 26; P.T-day 12; Evg. 203).

ASHTON-U-LYNE, Heginbottom School of Art, Lancs. 261 (F.T. 19; P.T-day 38; Evg. 204).

BARNSLEY, School of Art and Crafts. 397 (F.T. 23; P.T-day 104; Evg. 269).

BATH, Academy of Art. 155 (F.T. 43; P.T-day 3; Evg. 109).

BIRMINGHAM, College of Art and Crafts. 5,060 (F.T. 493; P.T-day 1,117; Evg. 3,450).

BIRMINGHAM, Bournville School of Art and Crafts. 705 (F.T. 25; P.T-day 207; Evg. 473).

BIRKENHEAD, Laird School of Art. 489 (F.T. 36; P.T-day 65; Evg. 388).

BOLTON, Municipal School of Art. 847 (F.T. 31; P.T-day 130; Evg. 686).

BOURNEMOUTH, Municipal College of Art. 1,150 (F.T. 162; P.T-day 108; Evg. 880).

BRADFORD, Regional College of Art. 1,328 (F.T. 102; P.T-day 268; Evg. 958).

BRIGHTON, College of Art and Crafts. 1,786 (F.T. 292; P.T-day 387; Evg. 1,107).

BRISTOL, West of England Art College. 1,336 (F.T. 194; P.T-day 233; Evg. 909).

BROMLEY, College of Art. 1,683 (F.T. 182; P.T-day 604; Evg. 897).

BURNLEY, Municipal School of Art. 792 (F.T. 17; P.T-day 323; Evg. 542).

BURTON-ON-TRENT, School of Art and Crafts. **410** (F.T. 6; P.T-day 90; Evg. 314).
CANTERBURY, College of Art. **853** (F.T. 184; P.T-day 190; Evg. 479).
CARDIFF, College of Art. **1,170** (F.T. 165; P.T-day 245; Evg. 760).
CARLISLE, Art School. **866** (F.T. 66; P.T-day 192; Evg. 608).
CHELTENHAM, College of Art. **851** (F.T. 87; P.T-day 170; Evg. 594).
CHESTER, Art School. **402** (F.T. 42; P.T-day 70; Evg. 290).
CHESTERFIELD, College of Art. **745** (F.T. 50; P.T-day 222; Evg. 473).
COVENTRY, College of Art. **1,508** (F.T. 92; P.T-day 283; Evg. 1,133).
CROYDON, School of Art. **943** (F.T. 112; P.T-day 237; Evg. 594).
DARLINGTON, School of Art. **342** (F.T. 25; P.T-day 55; Evg. 262).
DERBY, College of Art. **2,000** (F.T. 94; P.T-day 606; Evg. 1,300).
DONCASTER, School of Art and Crafts. **514** (F.T. 48; P.T-day 79; Evg. 387).
EASTBOURNE, School of Art. **272** (F.T. 25; P.T-day 45; Evg. 202).
EDINBURGH, College of Art, Lauriston Place. 3. **1,220** (F.T. 439; P.T-day 69; Evg. 712).
EPSOM AND EWELL, School of Art and Crafts, Surrey. **1,206** (F.T. 98; P.T-day 449; Evg. 659).
EXETER, Central College of Art. **391** (F.T. 23; P.T-day 89; Evg. 279).
GILLINGHAM, Medway College of Art. **1,610** (F.T. 162; P.T-day 186; Evg. 1,262).
GLASGOW, School of Art, Renfrew Street, C.3. **1,148** (F.T. 309; P.T-day 216; Evg. 623).
GLOUCESTER, College of Art. **727** (F.T. 34; P.T-day 216; Evg. 477).
GRAVESEND, Art School. **448** (F.T. 71; P.T-day 42; Evg. 335).
GUILDFORD, School of Art. **1,061** (F.T. 137; P.T-day 369; Evg. 555).
HARROGATE, School of Art. **866** (F.T. 39; P.T-day 110; Evg. 717).
HASTINGS, School of Art. **454** (F.T. 52; P.T-day 112; Evg. 290).
HEREFORD, School of Art and Crafts. **275** (F.T. 23; P.T-day 89; Evg. 163).
HORNSEY, School of Art and Crafts. **1,769** (F.T. 248; P.T-day 196; Evg. 1,325).
IPSWICH, School of Art. **570** (F.T. 50; P.T-day 140; Evg. 380).
KEIGHLEY, School of Art and Crafts. **489** (F.T. 24; P.T-day 77; Evg. 388).
KINGSTON-UPON-HULL, Regional College of Art and Crafts. **1,338** (F.T. 145; P.T-day 234; Evg. 959).
KINGSTON-ON-THAMES, School of Art. **998** (F.T. 256; P.T-day 79; Evg. 663).
LANCASTER AND MORECAMBE, College of Art and Crafts. **1,609** (F.T. 71; P.T-day 553; Evg. 985).
LEEDS, Regional College of Art. **1,879** (F.T. 316; P.T-day 230; Evg. 1,333).
LEEK, School of Art and Crafts. **227** (F.T. 8; P.T-day 67; Evg. 152).
LEICESTER, Regional College of Art. **3,109** (F.T. 333; P.T-day 762; Evg. 2,014).
LINCOLN, School of Art. **390** (F.T. 36; P.T-day 45; Evg. 309).

LIVERPOOL, College of Art. **2,023** (F.T. 202; P.T-day 552; Evg. 1,269).

LYDNEY, School of Art. **285** (F.T. 6; P.T-day 80; Evg. 199).

LONDON, Camberwell School of Art and Crafts, Peckham Road, S.E.5. **1.949** (F.T. 204; P.T-day 498; Evg. 1,247).

LONDON, Central School of Art and Crafts, Southampton Row, W.C.1. **2,279** (F.T. 356; P.T.-day 426; Evg. 1,497).

LONDON, Goldsmiths College of Art (University of London), S.E.14. **559** (F.T. 145; P.T-day 68; Evg. 346).

LONDON, Hammersmith School of Art and Crafts, Lime Grove, W.12. **1,129** (F.T. 80; P.T-day 147; Evg. 902).

LONDON, St. Martin's School of Art, Charing Cross Road, W.C.2. **2,617** (F.T. 401; P.T-day 187; Evg. 2,029).

LOUGHBOROUGH, College of Art. **1,096** (F.T. 71; P.T-day 160; Evg. 865).

MACCLESFIELD, School of Art. **299** (F.T. 6; P.T-day 58; Evg. 235).

MANCHESTER, Regional College of Art. **1,669** (F.T. 272; P.T-day 318; Evg. 1,074).

MANSFIELD, School of Art. **598** (F.T. 49; P.T-day 94; Evg. 455). Sec.Art.Sch. 49.

NEWCASTLE-UNDER-LYME, School of Art and Crafts. **266** (F.T. 26; P.T-day 30; Evg. 210).

NEWCASTLE-UPON-TYNE, College of Art and Industrial Design (commenced in 1953–4).

NEWTON ABBOT, Art School. **252** (F.T. 24; P.T-day 71; Evg. 157).

NORTHAMPTON, School of Art. **955** (F.T. 30; P.T-day 352; Evg. 573).

NOTTINGHAM, College of Art and Crafts. **1,896** (F.T. 230; P.T-day 460; Evg. 1,206).

OLDHAM, Municipal School of Art and Crafts. **597** (F.T. 18; P.T-day 157; Evg. 422).

PLYMOUTH, College of Art. **748** (F.T. 97; P.T-day 176; Evg. 475).

PORTSMOUTH, College of Art. **1,250** (F.T. 186; P.T-day 227; Evg. 837).

READING, University Art School. **121** (F.T. —; P.T-day 9; Evg. 112).

REIGATE AND REDHILL, School of Art and Crafts. **428** (F.T. 60; P.T-day 68; Evg. 300).

ROTHERHAM, School of Art and Crafts. **374** (F.T. 35; P.T-day 48; Evg. 291).

ST. ALBANS, School of Art. **544** (F.T. 52; P.T-day 109; Evg. 383).

ST. HELENS, Gamble Institute. **654** (F.T. 12; P.T-day 240; Evg. 402).

SALISBURY, School of Art and Crafts. **438** (F.T. 34; P.T-day 82; Evg. 322).

SELBY, Art School. **132** (F.T. 13; P.T-day 2; Evg. 117).

SHIPLEY, School of Art. **301** (F.T. —; P.T-day 28; Evg. 273).

SHEFFIELD, College of Art and Crafts. **1,268** (F.T. 111; P.T-day 174; Evg. 983).

SOUTHAMPTON, College of Art. **1,183** (F.T. 53; P.T-day 429; Evg. 701).

SOUTHPORT, College of Art and Crafts. **487** (F.T. 49; P.T-day 73; Evg. 365).

SOUTH SHIELDS, Art School. **354** (F.T. 27; P.T-day 60; Evg. 267).

STAFFORD, County School of Art and Crafts. **491** (F.T. 48; P.T-day 105; Evg. 341).

STOKE-ON-TRENT, College of Art. **1,320** (F.T. 99; P.T-day 275; Evg. 946).
STROUD, School of Art. **233** (F.T. 10; P.T-day 116; Evg. 107).
SUNDERLAND, College of Art. **945** (F.T. 105; P.T-day 163; Evg. 667).
SWANSEA, School of Art and Crafts. **552** (F.T. 73; P.T-day 112; Evg. 367).
TAUNTON, Somerset College of Art. **731** (F.T. 59; P.T-day 234; Evg. 438).
TUNBRIDGE WELLS, Art School. **650** (F.T. 51; P.T-day 142; Evg. 457).
WAKEFIELD, School of Art and Crafts. **1,052** (F.T. 33; P.T-day 484; Evg. 535).
WALLASEY, School of Art. **438** (F.T. 53; P.T-day 61; Evg. 324).
WALSALL, School of Art and Crafts. **945** (F.T. 12; P.T-day 221; Evg. 712).
WARRINGTON, School of Art. **445** (F.T. 6; P.T-day 75; Evg. 364).
WEST BROMWICH, Ryland Memorial School of Art and Crafts. **458** (F.T. 12; P.T-day 85; Evg. 361).
WEST HARTLEPOOL, College of Art. **1,109** (F.T. 61; P.T-day 207; Evg. 841).
WIMBLEDON, School of Art. **1,086** (F.T. 143; P.T-day 385; Evg. 558).
WINCHESTER, School of Art and Crafts. **506** (F.T. 50; P.T-day 119; Evg. 337).
WOLVERHAMPTON, College of Art and Crafts. **1,254** (F.T. 99; P.T-day 282; Evg. 873).
WORTHING, West Sussex College of Art and Crafts. **476** (F.T. 83; P.T-day 114; Evg. 279).
YORK, School of Art and Crafts. **795** (F.T. 57; P.T-day 123; Evg. 615).

II. *Schools of Art in Technical Colleges*

BELFAST, College of Technology.
BILSTON, College of Further Education. **281** (F.T. 11; P.T-day 61; Evg. 209).
BLACKBURN, Technical College. **537** (F.T. 15; P.T-day 128; Evg. 394).
BLACKPOOL, Technical College. **760** (F.T. 63; P.T-day 175; Evg. 522).
BURY, Technical College. **283** (F.T. 11; P.T-day 59; Evg. 213).
CAMBORNE, Cornwall Technical College. **199** (F.T. 6; P.T-day 95; Evg. 98).
CAMBRIDGE, Cambridgeshire Technical College and School of Art. **633** (F.T. 59; P.T-day 142; Evg. 432).
CHELMSFORD, Mid-Essex Technical College. **257** (F.T. 18; P.T-day 56; Evg. 183).
COLCHESTER, North East Essex Technical College. **261** (F.T. 33; P.T-day —; Evg. 228).
DAGENHAM, South-East Essex Technical College. **1,059** (F.T. 95; P.T-day 215; Evg. 749).
DEWSBURY AND BATLEY, Technical College. **804** (F.T. 32; P.T-day 246; Evg. 526).
DUDLEY AND STAFFORDSHIRE, Technical College. **228** (F.T. 13; P.T-day 41; Evg. 174).

EALING, Technical College, Middlesex. **1,145** (F.T. 85; P.T-day 103; Evg. 957).

GRIMSBY, College of Further Education, **467** (F.T. 16; P.T-day 113; Evg. 338).

HALIFAX, School of Art, Municipal Technical College. **428** (F.T. 10; P.T-day 135; Evg. 283).

HARROW, Technical College. **1,208** (F.T. 97; P.T-day 172; Evg. 939).

HUDDERSFIELD, Technical College. **872** (F.T. 85; P.T-day 195; Evg. 592).

LONDON, Borough Polytechnic. **531** (F.T. 34; P.T-day 153; Evg. 344).

LONDON, Chelsea Polytechnic. **644** (F.T. 157; P.T-day 89; Evg. 398).

LONDON, Sir John Cass College. **269** (F.T. 24; P.T-day 27; Evg. 218).

LONDON, The Polytechnic, Regent Street. **863** (F.T. 135; P.T-day 90; Evg. 638).

LONDON, Woolwich Polytechnic. **269** (F.T. 29; P.T-day 23; Evg. 217).

LUTON AND SOUTH BEDFORDSHIRE, Technical College. **257** (F.T. 47; P.T-day 21; Evg. 189).

MIDDLESBROUGH, The Constantine Technical College. **608** (F.T. 65; P.T-day 117; Evg. 426).

NELSON, Art School. **1,052** (F.T. 3; P.T.-day 462; Evg. 587).

NEWPORT, School of Art and Crafts. **1,179** (F.T. 70; P.T-day 332; Evg. 777).

NEWPORT, Technical College. **1,146** (F.T. 70; P.T-day 299; Evg. 777).

NORTHWICH, Verdin Technical College. **303** (F.T. 18; P.T-day 72; Evg. 213).

NORWICH, City College. **511** (F.T. 73; P.T-day 202; Evg. 236).

NUNEATON, Technical College. **751** (F.T. 14; P.T-day 440; Evg. 297).

OXFORD, College of Technology, Art and Commerce. **1,051** (F.T. 43; P.T-day 277; Evg. 731).

PRESTON, Harris Institute. **807** (F.T. 28; P.T-day 144; Evg. 635).

RUGBY, College of Technology and Art. **464** (F.T. —; P.T-day 256; Evg. 208).

SALFORD, Royal Technical College. **437** (F.T. 53; P.T-day 82; Evg. 302).

SCARBOROUGH, Technical Institute. **223** (F.T. 22; P.T-day 40; Evg. 161).

SHREWSBURY, Technical College. **467** (F.T. 32; P.T-day 108; Evg. 327).

SOUTHEND-ON-SEA, Municipal College. **955** (F.T. 49; P.T-day 12; Evg. 871).

STOCKPORT, College of Further Education. **692** (F.T. 34; P.T-day 156; Evg. 402).

SWINDON, The College. **421** (F.T. 22; P.T-day 61; Evg. 338).

TWICKENHAM, Technical College. **1,111** (F.T. 118; P.T-day 328; Evg. 665).

WALTHAMSTOW, South-West Essex Technical College. **743** (F.T. 81; P.T-day 80; Evg. 582)

WATFORD, Technical College. **385** (F.T. 29; P.T-day 114; Evg. 242).

WIGAN, Wigan and District Mining and Technical College. **365** (F.T. 23; P.T-day 83; Evg. 259).

WILLESDEN, Technical College. **645** (F.T. 92; P.T-day 57; Evg. 496).

WORCESTER, Victoria Institute. **312** (F.T. 10; P.T-day 94; Evg. 208).

YEOVIL, Technical College. **242** (F.T. 22; P.T-day 50; Evg. 170).

NATIONAL COLLEGES

Name and Address of Establishment	*No. of Full-time Students, 1953*	*Student Hours, 1953*
†National College of Horology and Instrument Technology, Northampton Polytechnic, St. John Street, E.C.1.	35	44,576
†National Foundry College, Wulfruna Street, Wolverhampton	32	28,370
†National College for Heating, Ventilating, Refrigeration and Fan Engineering, Borough Polytechnic, Borough Road, S.E.1	68	69,325
†*National College of Rubber Technology, Northern Polytechnic, Holloway Road, N.7	34	32,040
†National Leathersellers' College, Tower Bridge Road, Bermondsey, S.E.1	102	34,725
†*National College of Food Technology, Cranwood Street, City Road, E.C.1	31	13,426
Royal College of Art, South Kensington, S.W.7	399	372,950
College of Aeronautics, Cranfield, Bedfordshire	150	(not available)
	851	

ASSOCIATIONS REPRESENTING TECHNICAL INSTITUTIONS AND THEIR STAFFS

Association of Technical Institutions. Hon. Secretary, J. C. Jones, C.B.E., B.Sc.(Eng.), A.M.I.C.E., M.I.Mech.E., F.I.I.A., The Polytechnic, Regent Street, London, W.1.

Association of Principals of Technical Institutions. Hon. Secretary, A. W. Gibson, O.B.E., B.Sc.Tech., M.I.Mech.E., J.P., Dudley and Staffordshire Technical College, Dudley.

Association of Teachers in Technical Institutions. Dr. E. A. Seeley, Secretary, Hamilton House, Mabledon Place, London, W.C.1.

Association of Art Institutions. Hon. Secretary, Kenneth Holmes, O.B.E., A.R.C.A., College of Art, The Newarke, Leicester.

National Society for Art Education. Secretary, W. M. Whitehead, 89 London Road, Leicester.

WORKS SCHOOLS, 1952–3

The following are approved by the Ministry as efficient establishments. The number of students is given thus, F.T. = full-time; P.T.D. = part-time day; P.T.D. and E. = part-time day and evening; Evg. = evening only.

Gloucestershire

Cheltenham. Messrs. Smith's English Clocks Ltd., Works School (F.T. 59).

Filton, The Bristol Aeroplane Company's Works School (P.T.D. 446; P.T.D. and E. 304; Evg. 25).

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† in membership of A.T.I. (pp. 587, 163).
* in membership of A.P.T.I. (pp. 587, 163).

Hampshire

Portsmouth, Messrs. Knight and Lee, Day Continuation Classes (P.T.D. 22) (Note A).

Kent

Aylesford, Messrs. A. E. Reed and Co. Ltd., Works School (P.T.D. 271; P.T.D. and E. 58; Evg. 105).

Lancashire

Accrington, Messrs. Howard and Bullough Works School (P.T.D. 20; P.T.D. and E. 147).

Leyland Day Continuation School and Evening Institute (P.T.D. 85; P.T.D. and E. 290).

Prescot, British Insulated Callender's Cables Ltd., Works School (P.T.D. 318).

Stretford, Metropolitan Vickers Works School (F.T. 12; P.T.D. 1,064; P.T.D. and E. 323; Evg. 299).

Bolton, Tootal's Day Continuation School (P.T.D. 207).

Manchester, Mather and Platt Ltd., Works School (P.T.D. 181; P.T.D. and E. 145; Evg. 35).

Manchester, Messrs. Lewis's Ltd., Day Continuation Classes (P.T.D. 153).

Middlesex

Hendon, de Havilland Aeronautical Technical School (P.T.D. 95; P.T.D. and E. 10; Evg. 31).

Nottingham

Boots College (P.T.D. 1,441; P.T.D. and E. 103; Evg. 51).

Somerset

Street, Strode Day Continuation School (P.T.D. 256).

Warwickshire

Bournville Works Evening Institute (Evg. 876).

Yorkshire (East Riding)

Kingston-upon-Hull, Reckitt's Day Continuation School and Evening Institute (P.T.D. 540; P.T.D. and E. 62; Evg. 124).

York, Rowntree's Girls' Day Continuation School and Evening Institute (P.T.D. 634; Evg. 254).

Yorkshire (West Riding)

Stocksbridge Day Continuation School and Evening Institute (P.T.D. 123; Evg. 488).

Stourton, Yorkshire Copper Works Day Continuation Classes (P.T.D. 69) (Note A).

Leeds, Messrs. Lewis's Ltd., Day Continuation School (P.T.D. 149).

TOTAL ENROLMENTS	
Full-time	71
Part-time Day	5,774
Part-time Day and Evening	1,472
Evening only	2,288
TOTAL	9,605

NOTE A. Closed at end of 1952–3 Session.

UNIVERSITIES AND UNIVERSITY COLLEGES IN THE UNITED KINGDOM

Number of full-time students in Science and Technology, 1952–3

Institution	*Total Students*	*Science*		*Technology*	
		No.	*% of Total*	*No.*	*% of Total*
Birmingham University	3,076	649	21·1	709	23·1
Bristol University	2,578	693	26·9	213	8·2
Cambridge University	7,837	1,935	24·7	807	10·3
Durham University					
Durham Colleges	1,124	407	36·2	—	—
King's College, Newcastle	3,091	576	18·6	705	22·8
Exeter University College	980	368	37·6	—	—
Hull University College*	798	331	41·5	—	—
Leeds University	3,184	488	15·3	746	23·4
Leicester University College	723	276	38·2	—	—
Liverpool University	2,970	608	20·5	560	18·9
University of London, including the Colleges and Schools	18,199	3,113	17·1	1,801	9·9
Manchester University	4,025	1,071	26·6	420	10·6
Manchester College of Technology (Faculty only)	654	—	—	654	100·0
North Staffordshire University College	417	90	21·6	—	—
Nottingham University	2,037	590	29·0	233	11·4
Oxford University	6,878	1,144	16·6	60	0·9
Reading University	1,100	280	25·5	—	—
Sheffield University	2,029	430	21·2	504	24·9
Southampton University	933	365	39·1	110	11·8
Total England	62,635	13,414	21·4	7,531	12·0
University of Wales					
Aberystwyth University College	1,071	308	28·8	—	—
Bangor University College	861	237	27·5	39	4·5
Cardiff University College	1,533	432	28·2	199	13·0
Swansea University College	894	311	34·8	147	16·4
Welsh National School of Medicine	262	68	28·0	—	—
Total Wales	4,621	1,356	29·3	385	8·3

* Now Hull University.

Institution	*Total Students*	*Science*		*Technology*	
		No.	*% of Total*	*No.*	*% of Total*
Aberdeen University	1,752	266	15·2	94	5·3
Edinburgh University	4,593	600	13·1	250	5·4
Glasgow University	4,965	759	15·3	619	12·5
Glasgow Royal Technical College	1,211	177	14·6	1,034	85·4
St. Andrews University, including Dundee University College	1,697	429	25·3	80	4·7
TOTAL SCOTLAND	14,218	2,231	15·7	2,077	14·6
TOTAL FOR GREAT BRITAIN	81,474	17,001	20·9	9,993	12·3

Sources: University Grants Committee Returns for 1952–3 (H.M.S.O.); *University Grants Committee.* Secretary, Sir Edward Hale, K.B.E., C.B., 38 Belgrave Square, London, S.W.1.

SCOTTISH CENTRAL TECHNICAL INSTITUTIONS

- Aberdeen
  - Robert Gordon's Technical College
  - The North of Scotland College of Agriculture
- Dundee
  - Dundee Institute of Art and Technology
- Edinburgh
  - Edinburgh and East of Scotland College of Agriculture
  - Edinburgh College of Art
  - Edinburgh College of Domestic Science
  - Heriot-Watt College
  - Leith Nautical College
- Galashiels
  - The Scottish Woollen Technical College
- Glasgow
  - Glasgow and West of Scotland College of Domestic Science
  - Scottish College of Commerce
  - Glasgow School of Art
  - The Royal Technical College
  - The West of Scotland Agricultural College
  - The Royal Scottish Academy of Music
- Paisley
  - Paisley Technical College

THE TRAINING COLLEGES FOR TEACHERS OF TECHNICAL SUBJECTS

Further information can be obtained from the following:

The Director, Bolton Training College, The Technical College, Bolton.
The Principal, Garnett College, 83 New Kent Road, London, S.E.1.
The Director, Huddersfield Technical Training College, Queen Street South, Huddersfield.

RECOGNITIONS OF COURSES IN TECHNICAL INSTITUTIONS FOR INCREASED GRANTS UNDER CIRCULAR 255—ADVANCED TECHNOLOGY

The following recognitions obtained as at 30th June, 1954:

No. of Local Education Authorities submitting applications .	52
No. of Technical Colleges	89
No. of Courses	1,200

Applications Considered

Courses approved: 426 at 24 Technical Colleges.

These courses may be classified as follows:

	Full-time		Part-time	
	Degree	Non-Degree	Degree	Non-Degree
Engineering				
Mechanical	—	9	—	28
Electrical	25	7	12	55
Civil	—	—	—	—
Other	—	7	—	46
Chemistry	14	16	12	34
Physics	9	4	11	11
Mathematics	6	1	8	4
Pharmacy	6	2	—	1
Metallurgy	3	4	3	7
Botany, Zoology, Geology	6	—	4	3
B.Sc. General	21	—	22	—
Building	—	4	—	10
Textiles	—	3	—	1
Naval Architecture	—	1	—	—
Plastics	—	—	—	2
Pottery	—	2	—	2
TOTALS	90	60	72	204

LIST OF COLLEGES IN WHICH COURSES OF ADVANCED TECHNOLOGY HAVE BEEN APPROVED FOR 75% GRANT REGULATION 13 OF GRANT REGULATIONS No. 1, 1952, AS AT JUNE 30TH, 1954

Acton Technical College, High Street, Acton, W.3.
Birmingham, College of Technology.
Bradford Technical College.
Brighton Technical College, Richmond Terrace, Brighton.
Cardiff, College of Technology and Commerce.
Glamorgan Technical College, Llantwit Road, Treforest, Glam.
Huddersfield, Technical College.
Leicester, College of Technology and Commerce.
City of Liverpool College of Building, Clarence Street, Liverpool 3.
London: Battersea Polytechnic, Battersea Park Road, Battersea, S.W.11.
London: Brixton School of Building, Brixton, S.W.4.

London: Chelsea Polytechnic, Manresa Road, Chelsea, S.W.3.
London: Northampton Polytechnic, 280 St. John's Street, E.C.1.
London: Northern Polytechnic, Holloway Road, N.7.
London: Sir John Cass College, Jewry Street, Aldgate, E.C.3.
London: The Polytechnic, Regent Street, W.1.
London: Woolwich Polytechnic, Thomas Street, Woolwich, S.E.18.
Manchester College of Technology (non-faculty courses).
North Staffordshire Technical College, Victoria Road, Stoke-on-Trent.
Nottingham and District Technical College, Shakespeare Street, Nottingham.
Rugby, College of Technology and Art, Eastlands, Rugby.
Salford, Royal Technical College, Peel Park, Salford 5.
Sunderland, Technical College.
West Ham College of Technology, West Ham.

RECOGNITIONS OF COURSES

On the next four pages will be found details of recognitions of courses. Attention is called to the notes at the foot of page 613

RECOGNITIONS OF COURSES

Col. Number—See Notes at foot of Table	1	2	3	4	5	6	7	8
Recognition granted/recognition granting body	** Circular 255 Grant* — *C Central Institution, Scotland*	*London University Internal Degrees*	*London University B.Sc. (Eng.) External Degrees*	*Other London University B.Sc. (Eng.) External Degrees*	*Royal Institute of Chemistry (A.R.I.C.)*	*Institute of Physics*	*Higher National Diploma (H.N.D.)*	*Higher National Certificate H.N.C. (Part-time day)*
Technical Institutions								
Aberdeen, Robert Gordon's Technical College	C	—	*	—	—	—	—	*
Acton Technical College	*	—	*	—	*	*	—	*
Belfast, College of Technology	—	—	*	—	—	—	—	*
Barnsley, Mining and Technical College	—	—	*	* Min.	*	—	—	*
Birmingham, College of Technology	*	—	*	* CE Mt.	*	*	*	*
Blackburn Technical College	—	—	—	—	*	*	—	*
Bolton Technical College	—	—	—	—	*	—	—	*
Bournemouth College of Technology and Commerce	—	—	*	—	—	—	*	*
Bradford Technical College	*	—	*	* CE Mt.	*	*	—	*
Brighton Technical College	*	—	*	—	*	*	*	*
Bristol College of Technology	—	—	—	—	*	—	—	*
Burnley Technical College	—	—	*	—	*	—	—	*
Cardiff College of Technology and Commerce	*	—	*	—	*	*	—	*
Chelmsford, Mid-Essex Technical College	—	—	—	—	*	*	—	*
Cheltenham, North Gloucestershire Technical College	—	—	*	—	—	—	—	*
Chesterfield, College of Technology	—	—	*	—	*	—	*	*
Coventry Technical College	—	—	*	—	*	—	—	*

Crumlin, Technical College of Monmouthshire	—	—	—	—	*	—	—	*
Dagenham, South-East Essex Technical College	—	—	—	—	*	*	—	*
Dartford, County Technical College	—	—	*	—	—	—	—	*
Derby Technical College	—	—	*	—	*	*	—	*
Doncaster Technical College	—	—	—	—	*	—	—	*
Dundee Technical College	—	—	*	—	—	—	—	*
Edinburgh, Heriot-Watt College	C	—	*	* Min.	—	*	—	*
Gillingham, Medway Technical College	—	—	*	—	*	—	—	*
Glasgow, Royal Technical College	C	—	*	* Mt.	—	*	—	*
Gloucester Technical College	—	—	—	—	*	*	—	*
Guildford Technical College	—	—	—	—	—	*	—	*
Halifax, Technical College	—	—	*	—	*	—	—	*
Huddersfield Technical College	*	—	*	—	*	*	*	*
Hull Technical College	—	—	*	—	*	—	—	—
Ipswich School of Technology	—	—	—	—	*	—	—	*
Kingston-on-Thames Technical College	—	—	*	—	*	*	*	*
Lancaster and Morecambe College of Further Education	—	—	—	—	*	—	—	*
Leeds College of Technology	—	—	*	—	*	*	*	*
Leicester College of Technology and Commerce	—	—	*	—	—	—	—	*
Liverpool College of Technology	—	—	—	—	*	*	—	*
College of Building	*	—	—	*	—	—	—	*
London, Battersea Polytechnic	*	* Sc.Eng.	*	* CE Mt.	*	*	—	*
Borough Polytechnic	—	—	—	—	*	*	*	*
Brixton School of Building	*	—	—	—	—	—	*	*
Chelsea Polytechnic	*	* Sc.	—	—	*	*	—	
Northampton Polytechnic	*	* Eng.	*	—	*	*	—	*
Northern Polytechnic	*	* Sc.	—	—	*	*	—	—
Norwood Technical College	—	—	—	—	*	*	—	—

RECOGNITIONS OF COURSES

Col. Number—See Notes at foot of Table	1	2	3	4	5	6	7	8
Recognition granted/recognition granting body	** Circular 255 Grant* — *C Central Institution, Scotland*	*London University Internal Degrees*	*London University B.Sc. (Eng.) External Degrees*	*Other London University B.Sc. (Eng.) External Degrees*	*Royal Institute of Chemistry (A.R.I.C.)*	*Institute of Physics*	*Higher National Diploma (H.N.D.)*	*Higher National Certificate H.N.C. (Part-time) day)*
Technical Institutions								
The Polytechnic	*	—	*	—	*	*	—	*
Sir John Cass College	*	* Sc.	* Mt.	—	*	*	—	—
South East London Technical College	—	—	—	—	—	*	—	*
Woolwich Polytechnic	*	* Sc.Eng.	*	—	*	*	—	*
Loughborough, College of Technology	—	—	*	* CE	*	*	—	—
Luton and South Bedfordshire Technical College	—	—	*	—	—	—	—	*
Manchester College of Technology	—	—	*	* Mt.	*	*	*	*
Middlesbrough, Constantine Technical College	—	—	*	* Mt.	*	—	*	*
Neath Technical College	—	—	—	—	*	—	—	*
Newcastle, Rutherford Technical College	—	—	—	—	*	—	—	*
Newport (Mon.) Technical College	—	—	—	—	*	—	—	*
Northampton College of Technology	—	—	—	—	*	—	—	—
Norwich, City College	—	—	*	—	*	—	—	*
Nottingham and District Technical College	*	—	*	—	*	*	—	*
Oxford College of Technology, Art and Commerce	—	—	*	—	*	*	—	*
Paisley Technical College	C	—	*	—	—	—	—	

Plymouth and Devonport Technical College	—	—	*	—	*	—	*	*
Portsmouth College of Technology	—	—	*	—	*	*	*	*
Preston, Harris Institute	—	—	*	—	*	*	—	*
Rotherham College of Technology	—	—	*	* Mt.	*	*	—	*
Rugby College of Technology and Arts	*	—	*	—	*	—	—	*
St. Helens Technical College	—	—	*	—	*	—	—	*
Salford, Royal Technical College	*	—	*	—	*	*	*	*
Southend-on-Sea Municipal College	—	—	—	—	*	—	—	*
Stockport College of Further Education	—	—	—	—	*	—	—	*
Stoke-on-Trent, North Staffordshire Technical College	*	—	*	—	*	—	—	—
Sunderland Technical College	*	—	*	—	*	*	*	*
Swansea Technical College	—	—	—	—	*	*	—	*
Treforest, Glamorgan Technical College	*	—	*	—	*	*	*	*
Walthamstow, South-West Essex Technical College	—	*	—	—	*	*	—	*
Wednesbury Technical College	—	—	—	* Mt.	—	—	—	*
West Ham College of Technology	*	* Sc.Eng.	*	* CE	*	*	—	*
Widnes Technical College	—	—	—	—	*	—	—	*
Wigan and District Mining and Technical College	—	—	*	* Min.	*	*	—	*
Wolverhampton and Staffordshire Technical College	—	—	*	—	*	*	—	*
Wrexham, Denbighshire Technical College	—	—	—	—	*	—	—	*

NOTES

Col. 1: C indicates Scottish Central Institution, for complete list see p. 606; *indicates Circular 255—75% grant, see p. 471.

Col. 2: Sc.=Science Degrees. Eng.=Engineering Degrees.

Col. 4: CE=Chemical Engineering; Mt.=Metallurgy; Min.=Mining.

Col. 5: Recognition for training of students in preparation for the examinations for the Associateship of the Royal Institute of Chemistry (A.R.I.C.).

Col. 6: Recognition for training students for graduateship, A.Inst.P., and F.Inst.P.

NATIONAL ADVISORY COUNCIL ON EDUCATION FOR INDUSTRY AND COMMERCE (ENGLAND AND WALES)

Curzon Street House, Curzon Street, London, W.1.

Constitution

London and Home Counties Regional Advisory Council for Higher Technological Education:

1 Representative for the Universities
2 Representatives for the Local Authorities
2 ,, ,, ,, Teachers
1 Representative for the Employers
1 ,, ,, ,, Employees

The following:

Southern Regional Council for Further Education
Regional Council for Further Education for the South-west
West Midlands Advisory Council for Technical Commercial and Art Education
Regional Advisory Council for the Organisation of Further Education in the East Midlands
East Anglian Regional Advisory Council for Further Education
Yorkshire Council for Further Education
Northern Advisory Council for Further Education
North Western Regional Advisory Council for Further Education
Welsh Joint Education Committee

each nominate

1 Representative for the Universities
1 ,, ,, ,, Local Education Authorities
1 ,, ,, ,, Teachers
1 ,, ,, ,, Employers
1 ,, ,, ,, Employees

The Minister of Education nominates 20 representatives which at present cover the following interests:

Association of Education Committees: Wool Industry: Management Education: Glass Technology: Chemical Engineering: Banking: General Clerical and Administrative Work—Commerce: Civil Engineering: Electrical Engineering: Education and Research—Rayon: Petroleum Technology: Grocery Trades: Building: Insurance: Industrial Art and Design: Management and 'Time and Motion Study': Steel Industry: Cotton Industry (Technologist): Dress Design and Women's Clothing Trades: Plastics Consultant.

REGIONAL ADVISORY COUNCILS FOR FURTHER EDUCATION: ENGLAND AND WALES

London and Home Counties Regional Council for Higher Technological Education, Tavistock House South, Tavistock Square, London, W.C.1.

Southern Regional Council for Further Education, Shire Hall, Reading.

Regional Council for Further Education in the South-West, 12 Lower Castle Street, Bristol 1.

West Midlands Advisory Council for Technical, Commercial and Art Education, 141 Great Charles Street, Birmingham 3.

Regional Advisory Council for Further Education in the East Midlands, 12 King John's Chambers, Bridlesmith Gate, Nottingham.

East Anglian Regional Advisory Council for Further Education, County Education Office, Stracey Road, Norwich.

Yorkshire Council for Further Education, 35 Park Square, Leeds 1.

Regional Advisory Council for Further Education in the North-West, 33 Blackfriars Street, Manchester 3.

Northern Advisory Council for Further Education, 5 Grosvenor Villas, Grosvenor Road, Newcastle-upon-Tyne 2.

Welsh Joint Education Committee (Technical Education and Further Education Department), 2 Cathedral Road, Cardiff.

REGIONAL ADVISORY COUNCILS FOR TECHNICAL EDUCATION IN SCOTLAND

Aberdeen and North-East Regional Advisory Council for Technical Education, Robert Gordon's Technical College, Aberdeen.

Dundee and District Regional Advisory Council for Technical Education, 17 Bell Street, Dundee.

Edinburgh and South-East of Scotland Regional Advisory Council for Technical Education, Heriot-Watt College, Edinburgh 1.

Glasgow and West of Scotland Regional Advisory Council for Technical Education, Royal Technical College, Glasgow, C.1.

Highlands and Islands Regional Advisory Council for Technical Education, 33 Academy Street, Inverness.

SOME GOVERNMENT AND PUBLIC OFFICES

Only those most directly related to technical education have been selected.

Ministry of Education, The Permanent Secretary, Curzon Street, London, W.1.

Scottish Education Department, The Secretary, St. Andrew's House, Edinburgh 1.

Ministry of Education for Northern Ireland, The Permanent Secretary, Netherleigh, Massey Avenue, Belfast.

Ministry of Agriculture and Fisheries, The Permanent Secretary, 3 Whitehall Place, London, S.W.1.

Central Scholarships Committee and Agricultural Post-Graduate Scholarships Committee, 1–4 Cambridge Terrace, Regents Park, London, N.W.1.

British Broadcasting Corporation, Portland Place, London, W.1.

Ministry of Fuel and Power, Thames House South, Millbank, London, S.W.1.

Ministry of Health, Savile Row, London, W.1.

Ministry of Labour and National Service, 8 St. James's Square, London, S.W.1.

Medical Research Council, 38 Old Queen Street, Westminster, London, S.W.1.

Department of Scientific and Industrial Research, Charles House, 5–11 Lower Regent Street, London, S.W.1.

The National Coal Board, Hobart House, Grosvenor Place, London, S.W.1.

The British Electricity Authority, Great Portland St., London, W.1.

The Railway Executive, 222 Marylebone Road, London, N.W.1.

The Gas Council, Gas Industry House, 1 Grosvenor Place, London, S.W.1.

CONSTITUTION OF THE BURNHAM TECHNICAL COMMITTEE

Authorities' Panel		*Teachers' Panel*	
County Councils Association	4	Association of Teachers in Technical Institutions	6
Association of Municipal Corporations	3	Association of Principals of Technical Institutions	2
Association of Education Committees	3	National Society of Art Masters	2
London County Council	2	National Union of Teachers	2
Welsh Joint Education Committee, Local Authorities Sub-committee	1	National Federation of Teachers	1
TOTAL	13		13

Joint Honorary Secretaries; one member from each panel; at present the Secretary of the Association of Education Committees, and the Secretary of the Association of Teachers in Technical Institutions.

REGIONAL EXAMINING UNIONS AND OTHER EXAMINING BODIES

Union of Lancashire and Cheshire Institutes, 33 Blackfriars Street, Manchester 3.

Union of Educational Institutions, 25a Paradise Street, Birmingham 1.

East Midlands Educational Union, 32 Dryden Street, Nottingham.

Northern Counties Technical Examinations Council, 5 Grosvenor Villas, Grosvenor Road, Newcastle-upon-Tyne 2.

City and Guilds of London Institute, 31 Brechin Place, London, S.W.7.

The Royal Society of Arts, 28 Victoria Street, London, S.W.1.

The London Chamber of Commerce, 69 Cannon Street, London, E.C.4.

The Association of British Chambers of Commerce, 14 Queen Anne's Gate, London, S.W.1.

The National Committee (Scotland) for Commercial Certificates, 173 Pitt Street, Glasgow, C.2.

PROFESSIONAL INSTITUTIONS, EDUCATIONAL SOCIETIES AND ASSOCIATIONS

Accountants, Association of Certified and Corporate, 22 Bedford Square, W.C.1.

Accountants of Scotland, Institute of Chartered, 27 Queen Street, Edinburgh 2, and 218 St. Vincent Street, Glasgow, C.2.

Accountants of England and Wales, Institute of Chartered, Moorgate Place, E.C.2.

Accountants, Institute of Cost and Works, 63 Portland Place, W.1.
Accountants and Auditors, Society of Incorporated, Incorporated Accountants Hall, Temple Place, Victoria Embankment, W.C.2.
Actuaries, The Institute of, Staple Inn Buildings, Holborn, W.C.1.
Adult Education, The National Institute of, 35 Queen Anne Street, S.W.1.
Advertising Association, The, 110 Fleet Street, E.C.4.
Advertising, Institute of Incorporated Practitioners in, 44 Belgrave Square, S.W.1.
Aeronautical Society, The Royal, 4 Hamilton Place, W.1.
Agricultural Engineers, The Institute of British, 24 Portland Place, W.1.
Agricultural Society of England, The Royal, 16 Bedford Square, W.C.1.
Agricultural Society of Scotland, The Royal Highland, 8 Eglington Crescent, Edinburgh.
Architects, The Royal Institute of British, 66 Portland Place, W.1.
Architects, Institute of Naval, 10 Upper Belgrave Street, S.W.1.
Architects, Institute of Registered, 47 Victoria Street, S.W.1.
Architects and Surveyors, Faculty of, 40 Portman Place, W.1.
Architects and Surveyors, The Incorporated Association of, 75 Eaton Place, S.W.1.
Arts Council of Great Britain, The, 4 St. James Square, S.W.1.
Art Education, National Society for, 89 London Road, Leicester.
Art, Society for Education in, 37 Dennison House, 986 Vauxhall Bridge Road, S.W.1.
Bakery Education, National Board for, 1 Buckingham Palace Gardens, Buckingham Palace Road, S.W.1.
Biology, The Institute of, Tavistock House South, Tavistock Square, W.C.1.
Boot and Shoe Institution, The British, 35 College Street, Northampton.
Brewing, The Institute of, 33 Clarges Street, W.1.
British Association for the Advancement of Science, Burlington House, W.1.
British Industries, Federation of, 22 Tothill Street, S.W.1.
British Standards Institution, 2 Park Street, W.1.
Builders, The Institute of, 48 Bedford Square, W.C.1.
Caterers Association of Great Britain, 185 Oxford Street, W.1.
Ceramics Institute, The British.
Chemical Industry, The Society of, 14-16 Belgrave Square, S.W.1.
Chemical Manufacturers, Association of British, 86 Strand, W.C.2.
Chemical Society, The, Burlington House, Piccadilly, W.1.
Chemists, The British Association of, Huchley House, 14 Handley Street, W.1.
Chemistry, The Royal Institute of, 30 Russell Square, W.C.1.
Coking Industry Association, The British, 74 Grosvenor Street, W.1.
Chiropodists, The Joint Council of, 59 Gloucester Place, W.1.
Chiropodists, The Society of, 121 Cavendish Square, W.1.
Clothing Institute, The, 17 Henrietta Street, W.C.2.
Clerks of Works Institute of Great Britain, 5 Broughton Road, Thornton Heath, Surrey.
Colour Council, The British, 13 Portland Square, W.1.
Commerce, Association of British Chambers of, 14 Queen Anne's Gate, S.W.1.
Concrete Federation, British Cast, 17 Amherst Road, London, W.13.
Cotton Board, The, Fountain House, Fountain Street, Manchester 2.

Decorators, The Incorporated Institute of British, Drayton House, Gordon Street, W.C.1.
Design and Industries Association, 13 Suffolk Street, S.W.1.
Dietetics, The, British, Association (Inc.), 251 Brompton Road, S.W.3.
Domestic Studies, The National Council of, 75 Ferme Road, Ferme Park, N.8.
Dyers and Colourists, The Society of, 19 Piccadilly, Bradford, Yorks.
Economic Engineering, The Institute of, 28 Victoria Street, S.W.1.
Economic Society, The Royal, c/o The Marshall Library, Downing College, Cambridge.
Education Association, National, 72 Vallance Road, N.22.
Education Committees, Association of, 10 Queen Anne's Gate, W.1.
Education, UNESCO, Avenue Kleber, Paris 16eme.
Educational Institute of Scotland, The, 46 Moray Place, Edinburgh 3.
Educational Research, National Foundation for, 79 Wimpole Street, W.1.
Educational Visits and Exchanges, Central Bureau for, Hamilton House, Bidborough Street, W.C.1.
Electrical Association for Women, 35 Grosvenor Place, S.W.1.
Electrical Development Association, British, 2 Savoy Hill, W.C.2.
Electronics, The Institution for, 20 Buckingham Street, W.C.2.
Employers Confederation, British, 21 Tothill Street, S.W.1.
Engineering Draughtsmen and Designers, Institution of, Grand Buildings, Trafalgar Square, W.C.2.
Engineering Society, The Illuminating, 32 Victoria Street, S.W.1.
Engineers, The Institution of British Agricultural, 24 Portland Place, W.1.
Engineers, The Institution of Chemical, 56 Victoria Street, S.W.1.
Engineers, The Institution of Civil, Great George Street, Westminster, S.W.1.
Engineers, The Institution of Electrical, Savoy Place, W.C.2.
Engineers, Institution of Fire, 94 Southwark Bridge Road, S.E.1.
Engineers, The Institution of Gas, 17 Grosvenor Crescent, S.W.1.
Engineers Guild Ltd., The, 78 Buckingham Gate, S.W.1.
Engineers, The Institution of Heating and Ventilating, 75 Eaton Place, S.W.1.
Engineers, The Institution of Highway, 47 Victoria Street, S.W.1.
Engineers, Society of (Incorporated), 17 Victoria Street, S.W.1.
Engineers, The Institution of Locomotive, 28 Victoria Street, S.W.1.
Engineers, The Institution of Marine, 85 Minories, E.C.3.
Engineers, The Institution of Mechanical, Storey's Gate, St. James Park, W.1.
Engineers, The Institution of Mining, Salisbury House, Finsbury Circus, E.C.2.
Engineers, The Institution of Municipal, 84 Eccleston Square, S.W.1.
Engineers, The Institution of Production, 36 Portman Square, W.1.
Engineers, The British Institute of Radio, 9 Bedford Square, W.C.1.
Engineers, The Institution of Structural, 11 Upper Belgrave Street, S.W.1.
Engineers, The Institution of Water, Parliament Mansions, Abbey Orchard Street, S.W.1.
Examinations Board, Associated, City and Guilds of London Institute, 31 Brechin Place, S.W.7.
Exchange of Students for Technical Experience, The International Association for the (I.A.E.S.T.E.), Imperial College of Technology and Science, S.W.7.

Export, The Institute of, 140 Cromwell Road, S.W.7.
Faraday, The—Society, 6 Grays Inn Square, W.C.1.
Fuel, The Institute of, 18 Devonshire Street, Portland Place, W.1.
Gas Federation, The Women's, 1 Grosvenor Place, S.W.1.
Glass Technology, The Society of, 20 Hallam Gate Road, Sheffield 10.
Good Housekeeping, The Institute of, 30 Grosvenor Gardens, S.W.1.
Health, Royal Society for the Promotion of, 90 Buckingham Palace Road, S.W.1.
Highway Engineers, The Institution of, 47 Victoria Street, S.W.1.
Horological Institute, The British, 35 Northampton Square, E.C.1.
Hotel and Catering Institute, The, 24 Portman Square, W.1.
Housing, The Institute of, 37–38 Strand, W.C.2.
Housing and Town Planning Council (Inc.), National, 42 Devonshire Street, W.1.
Houseworkers, National Institute of, 52 Mount Street, W.1.
Industrial Administration, The Institute of, 8 Hill Street, W.1.
Industrial Psychology, The National Institute of, 14 Welbeck Street, W.1.
Industrial Technicians, The Institute of, 67 Lord Street, Liverpool 2.
Industrial Supervisors, The Institute of, 47 Temple Row, Birmingham 2.
Industrial Welfare Society, The, 48 Bryanston Square, W.1.
Institutional Management Association, The, 324 Grays Inn Road, W.C.1.
Insurance Institute, The Chartered, 20 Aldermanbury, E.C.2.
Iron and Steel Institute, The, 4 Grosvenor Gardens, S.W.1.
Launderers, The Institute of British—Ltd., 16–17 Lancaster Gate, W.2.
Management, The British Institute of, Management House, 8 Hill Street, W.1.
Mathematical Association, The, 87 Pixmore Way, Letchworth, Herts.
Meat, Institute of, Bristol House, Holborn Viaduct, E.C.1.
Medical Laboratory Technology, Institute of.
Metallurgical Education, Joint Committee on, 4 Grosvenor Gardens, S.W.1.
Metallurgists, The Institution of, 4 Grosvenor Gardens, S.W.1.
Metals, The Institute of, 4 Grosvenor Gardens, S.W.1.
Microscopical Society, The Royal, Tavistock House South, Tavistock Square, W.C.1.
Minerological Society, The, British Museum, S.W.7.
Mining Association of Great Britain, 96 Piccadilly, W.1.
Mining Institute of Scotland, Royal Technical College, Glasgow.
Mining and Metallurgy, The Institution of, Salisbury House, Finsbury Circus, E.C.2.
Mining Surveyors, The Institute of, 35 Church Street, Barnsley.
Motor Industry, Institute of the Incorporated, 40 Queen's Gate, S.W.7.
Municipal Treasurers and Accountants (Inc.), Institute of, 1 Buckingham Place, S.W.1.
Nursing Council for England and Wales, The General, 23, Portland Place, W.1.
Office Management Association, Management House, Hill Street, W.1.
Optical Association, The British, 65 Brook Street, W.1.
Optical Practitioners, The Association of, 65 Brook Street, W.1.
Parliamentary and Scientific Committee, 6 Queen Anne's Gate, S.W.1.
Painter-Etchers and Engravers, Royal Society of, 26 Conduit Street, W.1.
Painters-Sculptors-Engravers, National Society of, 195 Piccadilly, W.1.
Painters and Water Colours, The Royal Institute of, 195 Piccadilly, W.1.

Personnel Management, The Institute of, 2–10 Hill Street, W.1.
Petroleum, The Institute of, 26 Portland Place, W.1.
Pharmaceutical Society, The, 17 Bloomsbury Square, W.C.1.
Photographic Society, The Royal, 16 Princes Gate, S.W.7.
Photographers, Institute of British, 49 Gordon Square, W.C.1.
Physics, The Institute of, 47 Belgrave Square, S.W.1.
Plastics Institute, The, The Adelphi, Adam Street, W.C.2.
Plumbing Industry Further Education Council.
Preceptors, College of, 2–3 Bloomsbury Square, W.C.1.
Printers, The Federation of Master, 11 Beresford Row, W.C.1.
Productivity Council, British, 21 Tothill Street, S.W.1.
Public Administration, The Institute of, 76a New Cavendish Street, W.1.
Purchasing Officers Association, 146a Queen Victoria Street, E.C.4.
Quarrying, Institute of, Salisbury Square House, E.C.4.
Research, Department of Scientific and Industrial (D.S.I.R.), Charles House, 5–11 Regent Street, S.W.1.
Road Transport (Engineers Inc.), The Institute of, 69 Victoria Street, S.W.1.
Royal Institution of Great Britain, 21 Albemarle Street, W.1.
Royal Society, The, Burleigh House, Piccadilly, W.1.
Rubber Industry, The Institution of the, 12 Whitehall, W.1.
Rural Industries Bureau, 35 Camp Road, Wimbledon, S.W.19.
Sales Managers' Association, The Incorporated, 4 Holborn Place, W.C.1.
Sanitary Engineers, Institution of, 118 Victoria Street, S.W.1.
Seafarers' Education Service, College of the Sea, Mansbridge House, 207 Balham High Road, S.W.17.
Secretaries, The Chartered Institute of, 14 New Bridge Street, E.C.4.
Secretaries, The Corporation of, 28 Fitzroy Square, W.1.
Shipbrokers, The Institute of Chartered, 63 Fenchurch Street, E.C.3.
Spectacle Makers, The Worshipful Company of, Apothecaries Hall, Blackfriars Lane, E.C.4.
Statistical Society, The Royal, 21 Bentinck Street, London, W.1.
Surveyors, The Institute of Quantity, 99 Gloucester Place, S.W.1.
Surveyors, The Royal Institution of Chartered, 12 St. George Street, S.W.1.
Television Society, The, 164 Shaftesbury Avenue, W.C.2.
Textile Institute, The, 10 Blackfriars Street, Manchester 3.
Timber Development Association Ltd., The, 21 College Hill, E.C.4.
Town Planning Institute, 18 Ashley Place, S.W.1.
Trade Union Congress, Education Committee, Transport House, Smith Square, S.W.1.
Transport, The Institute of, 80 Portland Place, W.1.
Trichologists, The Institute of, 116 Gloucester Place, W.1.
Valuers' Institution, The, 68 Gloucester Place, W.1.
Visual Aids, Educational Foundation for, 33 Queen Anne Street, W.1.
Visual Education, Council for, 13 Suffolk Street, S.W.1.
Welding, Institute of, 2 Buckingham Palace Gardens, Buckingham Palace Road, S.W.1.
Wool Secretariat, The International, Dorland House, 18–20 Regent Street, W.1.
Workers' Educational Association, Temple House, 27 Portman Square, W.1.
Works Managers, Institution of, 67–68 Chandos Place, W.C.2.

NATIONAL CERTIFICATES AND DIPLOMAS

a. *National Certificates and Diplomas*

Subject	*Year of Introduction*	*Ministry of Education Rules Governing the Scheme No.:*
Mechanical Engineering	1921	106
Chemistry	1921	100
Applied Chemistry	1947	100
Electrical Engineering	1923	127
Naval Architecture	1926	105
Building	1929 Reconstituted 1948	101
Textiles	1934	102
Commerce	1939 Reconstituted 1951	104
Production Engineering	1941	106 (P)
Civil Engineering	1943	107
Applied Physics	1945	114
Metallurgy	1945	111
Chemical Engineering	1951	122
Mining	1952	123
Mine Surveying	1952	123

b. *Allied Schemes*

	Date of Establishment	*Ministry of Education Rules No.:*
National Craftsman's Certificate	1947	115
National Retail Distribution Certificates	1950	121
National Bakery Diploma	1950	117

c. *Ministry of Education and Certificates in Art*

including National Diploma in Design	1954	110

d. *Representatives on Joint Committees*

The Association of Technical Institutions, the Association of Principals of Technical Institutions, and the Association of Teachers in Technical Institutions are represented on the following Joint Committees:

Chemistry and Applied Chemistry
Commerce
Chemical Engineering
National Retail Distribution Certificates.

THE RESEARCH ASSOCIATIONS

NOTE: R.A.=Research Association

British Baking Industries, R.A., Baking Industries, R.S., Chorleywood, Herts.

British Boot, Shoe and Allied Trades, R.A., Satra House, Rockingham Road, Kettering, Northants.

British Cast Iron, R.A., Bordesley Hall, Alvechurch, Birmingham.
British Ceramic, R.A., Queen's Road, Penkhull, Stoke-on-Trent.
British Coal Utilisation, R.A., Randalls Road, Leatherhead, Surrey.
British Coke, R.A., 74 Grosvenor Street, London, W.1.
British Cotton Industry, R.A., Shirley Institute, Didsbury, Manchester.
Cutlery R. Committee, Light Trades House, Melbourne Avenue, Sheffield 10.
British Electrical and Allied Industries, R.A., Thorncroft Manor, Dorking Road, Leatherhead.
British Hat and Allied Feltmakers', R.A., Stanley House, Manchester Road, Droylsden, Lancs.
R.A. of British Flourmillers, 21 Arlington Street, London, S.W.1.
British Food Manufacturing Industries, R.A., Randalls Road, Leatherhead.
Fruit and Vegetable Canning and Quick Freezing, R.A., Chipping Campden, Glos.
R. Committee of the Furniture Development Council, 11 Adelphi Terrace, Robert Street, London, W.C.2.
British Gelatine and Glue Research Association, Sardinia House, 52 Lincoln's Inn Fields, London, W.C.2.
Hosiery and Allied Trades, 4 First Avenue, Sherwood Rise, Nottingham.
British Hydromechanics, R.A., Netteswell Road, Harlow, Essex.
British Internal Combustion Engine, R.A., 111–112, Buckingham Avenue, Trading Estate, Slough.
British Iron and Steel, R.A., 11 Park Lane, London, W.1.
British Jute Trade, R.A., Kinnoull Road, Kingsway West, Dundee.
Lace, R.A., Glaisdale Drive, Bilborough, Nottingham.
British Launderers', R.A., The Laboratories, Hill View Gardens, Hendon, N.W.4.
British Leather Manufacturers', R.A., Milton Park, Egham, Surrey.
Linen Industry, R.A., The Research Institute, Lambeg, Lisburn, Co. Antrim, Nr. Ireland.
Parsons and Marine Engineering Turbine, R. and Design A., Pametrada Research Station, Wallsend-on-Tyne.
Motor Industry, R.A., Great West Road, Brentford, Middlesex.
British Non-Ferrous Metals, R.A., Euston Street, London, N.W.1.
R.A. of British Paint, Colour and Varnish Manufacturers, The Paint Research Station, Waldegrave Road, Teddington, Middlesex.
British Paper and Board Industry, R.A., St. Winifred's Laboratories, Welcomes Road, Kenley, Surrey.
Printing, Packaging and Allied Trades, R.A., Patra House, Randalls Road, Leatherhead.
Production Engineering, R.A., of Great Britain, Staveley Lodge, Melton Mowbray, Leics.
British Rayon, R.A., Bridgewater House, 58 Whitworth Street, Manchester 1.
R.A. of British Rubber Manufacturers, Shawbury, Shrewsbury, Shropshire.
British Scientific Instrument, R.A., 20 Queen Anne Street, London, W.1.
British Shipbuilding, R.A., 5 Chesterfield Gardens, Curzon Street, London, W.1.
Coil Spring Federation, R.A., 40 Grosvenor Gardens, London, S.W.1.
Coal Tar, R.A., Oxford Road, Gomersal, Nr. Leeds.
British Welding, R.A., 29 Park Crescent, London, W.1.

R. Committee of the British Whiting Federation, 12 Buckingham Street, Strand, W.C.2.

Wool Industries, R.A., Torridon, Headingley, Leeds 6.

Association of Special Libraries and Information Bureaux, 4 Palace Gate, London, W.8.

Manchester Joint Research Council, Ship Canal House, King Street, Manchester 2.

Note:

Details of the Research Associations are given in the Annual Report of the Department of Scientific and Industrial Research (Charles House, 5–11 Regent Street, S.W.1), and in the Ministry of Education Letter to L.E.A's. (F.E.C.L., 10–54: Research Associations, T. 665/64).

COLLEGES WITH SANDWICH COURSES

NOTE: Where possible, after the name of the college the following are given in order:

Subject, e.g. Mech. Eng., Elect. Eng., Chem. Eng., or Bldg. Unusual subjects will be given fully.

Entry Standard, e.g. S.1, S.2, S.3, Adv. G.C.E., Ord. G.C.E.

Duration in years, e.g. 4y.

Period in college/industry, e.g. 6m/6m means 6 months each in college and industry, 1w/1w means 1 week turnabout.

Academic Award, e.g. H.N.D., O.N.D., H.N.C., O.N.C., etc. Coll. Assoc. = College Associateship. Coll.H.D. = College Higher Diploma.

Date Course Started.

Professionals exemptions are too varied to be denoted and information must be gained from the College.

BIRMINGHAM, College of Technology; Elect. Eng.; Ord. G.C.E./Adv. G.C.E.; 5y/4y; 6m/6m; Coll. Dipl. 1954.

BRISTOL, College of Technology; Bldg.; S.3; Adv. G.C.E.; 3½y; 7m/5m; H.N.D.; 1952. Mech. Eng.; 3y; 6m/6m; H.N.D.

BRISTOL, College of Commerce; Management Studies; 1y; 2 terms college, 1 term industry; no award.

CANNOCK CHASE, Mining and Technical College: Mining; 2y; 6m/6m; H.N.C. and Under Manager's Cert.

CARDIFF, College of Technology and Commerce; Bldg.; Adv. G.C.E.; 3y; 2 terms/1 term first 2 years only; H.N.D.; 1947.

COVENTRY, Technical College: Mech. Eng.; 3y; 6m/6m; Coll. Assoc.

CRUMLIN, Monmouthshire Technical College; Mech.Eng.; Ord. G.C.E.; 2y; 7m/5m; O.N.D.; 1952.

DARLINGTON, Technical College; Mech. Eng.; S.2; 4y; 6m/6m; H.N.D.; 1953.

ENFIELD, Technical College; Civil Eng.; Adv. G.C.E.; S.2; 4y; 6m/6m; professional exams. direct; 1953. Elect. Eng.; Adv. G.C.E.; S.3; 3½y; 6m/6m; H.N.D.; 1952. Mech. Eng.; Adv. G.C.E.; S.3; 3y; 6m/6m; H.N.D.; 1951. Prodn. Eng.; Adv. G.C.E.; S.3; 3y; 6m/6m; H.N.D.; 1951. Management Inter. and Final; 2y; 17 weeks college each year.

GATESHEAD, Technical College; Mech. Eng.; S.2; 4y; 6m/6m; H.N.D.; 1951.

HATFIELD, Technical College; Prelim. Diploma; S.1; 1y; 6m/6m; 1953. Eng. 2/3y; O.N.D./H.N.D.; 1944.

HENDON, Technical College; Mech. Eng.; Ord. G.C.E.; S1; 4y; 8w/8w; O.N.C., H.N.C., endorsements; 1952.

KINGSTON-UPON-HULL, Technical College; Aero. Eng.; 4y; 6m/6m; H.N.D.

KINGSTON-ON-THAMES, Technical College; Mech. Eng.; 3y; 6m/6m; H.N.D. Prodn. Eng.; 3y; 6m/6m; H.N.D.

LEEDS, College of Technology; Mech. Eng.; S.2; 4y; 6m/6m; H.N.D.; 1952. Elect. Eng.; S.2; 4y; 6m/6m; H.N.D.; 1953.

LEICESTER, College of Technology and Commerce; Industrial Management; 1y; 9 months directed reading sandwiched between 3 separate months full-time study in residence.

LONDON:

Brixton School of Building; Bldg.; Adv. G.C.E.; S.3; 3½y; 6m/6m; H.N.D.; 1951.

Borough Polytechnic; Elect. Eng.; Ord. G.C.E.; S.2; 4y; 6m/6m; H.N.D.; 1948. Mech. Eng.; Ord. G.C.E.; S.2; 4y; 6m/6m; H.N.D.; 1952.

Northampton Polytechnic; Aeronautical Eng.; S.2; 4y; 6m/6m; College Diploma; 1953.

South-East London Technical College; Elect. Eng.; Ord. G.C.E.; S.1; 4y; 1w/1w; O.N.C., H.N.C.; 1943. Mech. Eng.; S.1; Ord. G.C.E.; 4y; 1w/1w; O.N.C., H.N.C.; 1943.

Woolwich Polytechnic: Civil, Mech., Elect. Eng.; Adv. G.C.E.; 3y; adequate science subjects, 4y; 30w/22w; B.Sc. (London) and/or H.N.D.; 1934.

MIDDLESBROUGH, Constantine Technical College; Mech. Eng.; S.2; 3y; 6m/6m; H.N.D.; 1938; also S.1; 2y; 9m/3m; O.N.D.; 1952. Elect. Eng.; S.2; 3y; 6m/6m; H.N.D.; 1938. Struct. Eng.; S.2; 3y; 6m/6m; H.N.D.; 1941. Metallurgy; S.2; 3y; 6m/6m; Coll.H.D.; 1945. Chem.; S.2; 4y; 6m/6m; Coll.H.D./sit A.R.I.C. exam.; 1953. Pattern Making and Foundry Tech.; 2y; 9m/3m; College Ord. Dipl.

NEWCASTLE-ON-TYNE, Rutherford Technical College; Elect. Eng. and Mech. Eng.; each 3y; yrs 1 and 2-4m coll./8m industry; yr 3-8m coll./4m industry; O.N.D.

PORTSMOUTH, College of Technology; Elect. Eng.; S.2; 4y; 3m/3m; H.N.D.; 1952.

ROTHERHAM, Technical College; Mech. Eng.; S2; 4y; 6m/6m; H.N.D.; 1953.

RUGBY, College of Technology and Art; for London B.Sc.(Eng.); p-time day release to Part I Final, then 3rd term of 4th year and whole of 5th year full-time in college.

SALFORD, Royal Technical College; Mech. Eng.; S.2; 4y; 6m/6m; H.N.D. and Coll. Assoc.; 1949. Elect. Eng.; S.2; 4y; 6m/6m; H.N.D. and Coll. Assoc.; 1949. Bldg.; S.3; Adv. G.C.E.; 3y; 6m/6m; Coll. Assoc.; 1953. Textiles; Adv. G.C.E.; S.3; 3y; 7m/5m; Coll. Assoc.; 1953. Gas Eng. (Production and Distribution) O.N.C. Mech. or Chem.; 3y; 6m/6m; Coll. Assoc. 1954. Chemical Eng.; O.N.C. Mech. or Chem.; Adv. G.C.E.; 3y; 6m/6m; Coll. Assoc. 1955. Bakery; S.1; 3y; 6m/6m; Ord. National Bakery Dipl. 1954.

SMETHWICK, Chance Technical College; Metallurgy plus Production Engineering; S.1; 5y; O.N.C., H.N.C. Metall., H.N.C. Prodn. Eng.; 1946.

STAFFORD, Technical College; Elect. Eng.; 3y; yr I–1 term works; yr II–2 terms works; yr III–1 term works; H.N.D.

STOKE-ON-TRENT, North Staffordshire Technical College; Ceramics; G.C.E. Ord. with Chemistry; 3y; 6m/6m; Coll. Mgrs. Cert. in Pottery or Claywares; 1935. Vitreous Enamelling; G.C.E. Ord.; 3y; 6m/6m; College Managers Certif. Mech. Eng.; 3y; 6m/6m; O.N.C.; Elect. Eng.; 3y; 6m/6m; O.N.C.; Mining; 2y; 6m/6m; H.N.C. and Under Manager's Certif.

SUNDERLAND, Technical College; Elect. Eng.; S.2; Ord. G.C.E.; 3y; 6m/6m; H.N.D.; 1903; Mech. Eng.; S.2; Ord. G.C.E.; 3y; H.N.D.; 1903. Naval Architecture; S.2; Ord. G.C.E.; 3y; Coll. Dipl.; 1903. Bldg.; 3y; 6m/6m; H.N.D.

TREFOREST, Glamorgan Technical College; Mech. Eng.; S.2; Ord. G.C.E.; 4y; 6m/6m; H.N.D.; 1926. Chem. Eng.; S.2; Ord. G.C.E.; 4y; 6m/6m; Coll. Dip/sit A.R.I.C. exam.; 1918. Civil Eng.; S.2; Ord. G.C.E.; 4y; 6m/6m; Coll. Dip.; 1948. Mining Eng.; S.3; 3y; 6m/6m; Coll. Dip., Colliery Managers Certif. 1st Class; 1953. Mining Surveying; S.3; 2y; 6m/6m; Coll. Dip., Mining Surveyors Exam.; 1954.

WATFORD, Technical College; Eng.; 2y; O.N.C.

WEDNESBURY, Technical College; Metal; 3y; 6m/6m; H.N.C.

WIGAN, Mining and Technical College; Mech. Eng.; S.2; 4y; 6m/6m; H.N.D.; 1954.

WOLVERHAMPTON, and Staffordshire Technical College, Prodn. Eng.; S.3; 3y; 6m/6m; H.N.D.; 1953.

THE ENGINEERING JOINT EXAMINATION BOARD

This has been established by the Institution of Civil Engineers; The Institution of Mechanical Engineers; The Institution of Electrical Engineers; The Institution of Municipal Engineers; The Institute of Marine Engineers; The Royal Aeronautical Society; The Institution of Structural Engineers, for the purpose of examining, by means of tests in general education, such candidates for studentship and other grades as these Institutions may refer to it.

Enquiries for details should be addressed to the Secretary of the Institution concerned.

ADULT EDUCATION COLLEGES

The following provide courses of the kind mentioned on p. 192.

Ashridge, Berkhamsted, Herts.
Burton Manor, Wirral, Cheshire.
Cheshunt College, Cambridge.
Dillington House, Ilminster, Somerset.
Grantley Hall, Nr. Ripon, Yorks.
Holly Royde (University of Manchester Extra Mural Dept.), 30 Palatine Road, Withington, Manchester 20.
Pendley Manor, Tring, Herts.
Urchfont Manor, Nr. Devizes, Wilts.

NOTE. The National Institute of Adult Education (35 Queen Anne Street, W.1) publishes a Directory of Organisations, giving details of the foregoing colleges and many other adult education colleges and organisations.

SUBJECT INDEX

NOTE: A figure in bold type indicates the main reference

ABILITY IN THE POPULATION, 462
Ability of students, University, O.N.C. Craft, 226 *et seq.*
Ability required for jobs, 231 *et seq.*
Academic freedom and responsibility, 496
Accommodation schedule, 556
Accountants, Institute of Chartered, 365
Acton Society Trust Report, 180, 216
Administration, 481, 501, 545
  and Policy, 502 *et seq.*
  of college, diagram, 504
Administrative Staff College, 188, 213, 373, 519, 523
Administrative staffing, 545
Admin. Memo *134*, 213
Admin. Memo *425*, 527
Admin. Memo *490*, 585
Admin. Memo *502*, 527
Adult Education Colleges, 192, 625
Adult Education, link with technical, 523
Adult students, 509
Advertisements, 547
Advisory Committees, 131 *et seq.*
Advisory Councils, Regional, 135 *et seq.*
Aeronautical engineering, 254, 261
Aeronautics, 392
Affiliation with Universities, 497
Age groups of students, analysis of, 71, 72
Ageing population, 181 *et seq.*
Agricultural education, 13, 116, 391, **393**
Aids to teaching, 544
Ambulance Association, St. John, 343
American business schools, 376, **380** *et seq.*
American degrees, 459
American State Universities, selection within, 221
A.M.I.Mech.E.—H.N.C. holders, 260
Ancillary courses, 36
Ancillary subjects, importance in selection, 242
Apparatus, gifts from industry, 562
  Ministry of Education Circular *281*, 564
Applied Chemistry, National Certificates, 426, 430
Applied Physics, National Certificates, 435 *et seq.*
Apprenticeships—
  Building, 283
  Engineering, 247
  Reduction of period, 572
Aptitude Scheme, Special, Ministry of Labour, 195
Aptitudes and intelligence, 225 *et seq.*
Architects, for new buildings, appointment of, 556 *et seq.*
Architects, Royal Institute of British, 293, 320
Architecture, 293
Area Training Organisations, 321
Art College, function of, 329
Art Colleges and Schools—
  Entry conditions, 306 *et seq.*
  List of, 598 *et seq.*
  Number of, 8, 10
Art and Technical Colleges, co-operation, 326
Art Competitions, 318
Art Courses, enrolments in, 307
Art Education, National Society for, 166, 321
Art Education, regional arrangements, 325
Art Establishments—enrolments, 306
Art Examinations, National Advisory Committee, 317
Art Examining Bodies, 319
Art Exhibitions, 327
Art Institutions, Association of, 10, 166, 322
Art Intermediate Course, 310
Art Metalwork, 316
Art, preliminary training, 306
Art qualifications, 323
Art Scholarships, 309
Art Teachers, Courses, 312
  Training, 534
Art, The Royal College of, 323
Art, Society for Education in, 322
Art Teachers' Diploma (A.T.D.), 312
  Area Training Organisation, 321
  Colleges recognised, regional, 325
Art Training, and Ministry of Education, 321, 327
Articles and Schemes of Government, 486
Artists, 313
Arts, The Royal Society of, 146, **153** *et seq.*, 163, **321**
Ashridge, courses at, 192, 625

Assessed examinations, 157 *et seq.*
Associate Membership of Professional Institutions, 158
Associated Examinations Board, 83, 99, 152, 574
Associateships of Colleges, 85
Attendance, student hours in courses, 119
  recording part-time for firms, 208 *et seq.*
Automation, 390, 568
Automobile engineering practice, 278

B.A.C.I.E., 167
  Communications Institute, 519
Bakery, 394
  Education Advisory Committees (regional), 395
Bankers, Institute of, 365
Barlow Committee Report, 453 *et seq.*, 460
Beauty Culture, 351
Biochemistry, 443
Biographies, use in courses, 519
Biology, 442 *et seq.*
Biology, Institute of, 428, 443
Board of Studies, 504
Boiler Makers' work, 279
Bookbinding, 317
Boot and Shoe industry, 35
Boot and Shoe technology, 396
Boys' Clubs, National Association of, 193
Brathay Hall Centre, 193
Bray Committee Report on Art Examinations, 319, 328
Brewing, 443
Brewing, Institute of, 443
Brickwork, courses, 282
British Broadcasting Corporation, 615
British Electricity Authority, 616
British Employers' Confederation, 190, 618
British Red Cross Society, 343
B.Sc. (Eng.) London External Degree part-time day courses, 112
Builders, Institute of, 289, 617
Building Bulletin No. *5*, 121, 559, 564
Building Craft Courses, 282 *et seq.*
Building Education, future of, 302
Building Foremanship and Management Courses, 296
Building, full-time courses, 293 *et seq.*
Building industry, human problems of, 235
Building, National Apprenticeship Scheme, 283
Building, National Certificate Courses, 287 *et seq.*
Building, 23, 550 *et seq.*
  Programme and needs in further education, 550
  Progress in educational building, 552
  Analysis of major building projects, further education, 553
  Determination of needs, 554
Burnham Committees—
  Main Committee, 532
  Technical Committee, 532, 616
Burnham Technical Reports, 500, 532, 533, 580
  and Art Teachers, 323
Business schools in U.S.A., 376, 380
Business Training Scheme, 195

CARPENTRY AND JOINERY, 282
Careers pamphlets, 235
  Agriculture, 394
  Boot and Shoe, 396
  Building, 304
  Clothing Trades, 401
  Coal Mining, 403
  Commerce, 390
  Engineering, 280
  Foundry Work, 405
  Furniture and Timber, 407
  Gas Engineering, 408
  Gas Industry, 408
  Heating and Ventilating Engineering, 409
  Horticulture, 411
  Marine Engineering, 413
  Naval Architecture, 413
  Navigation and Nautical Courses, 415
  Printing, 419
  Women's Work, 360
Carr-Saunders Committee Report, 364, 367, 369
Catchment areas of colleges, 39 *et seq.*
Catering courses, 33, 346 *et seq.*
Cathedral services, 47, 51
Central Institutions, Scotland, 492, 534, 606
Central Scholarships Committee and Agricultural Post-Graduate Scholarships Committee, 615
Ceramics, 34, 397
Certification of Courses, 78
Chemical age, 38
Chemical engineering, 398
Chemical Engineers, Institution of, 399
Chemistry, 430 *et seq.*
  National Certificates (pure and applied), 430 *et seq.*
  Royal Institute of, 428, 431, 433
Cheshunt College, Cambridge, courses, 193
Child care, 333, 337 *et seq.*
Chiropody, 444 *et seq.*

Cine-technicians, 442
Circulars, Ministry of Education—
  Circular *87*, 136, 470
  Circular *94*, 470, 542
  Circular *98* 391 471, 484 *et seq.*
  Circular *117*, 338
  Circular *173*, 353
  Circular *245*, 377, 477, 552, 560, 570
  Circular *252*, 527
  Circular *255*, 280, 452, 471, 473, 527, 546, 577, 578
  Circular *255*, Recognised courses, 607 *et seq.*
  Circular *270*, 470
  Circular *281*, 214, 562, 564
  Circular *283*, 471, 477, 537, 554, 582
  Circular *289*, 586
City and Guilds of London Institute, 15, 22, 100, 114, 150 *et seq.*
  and Regional Examining Unions, 149
  Associated Examinations Board, 152
  Art, 320
  Building, 283 *et seq.*
  Cabinet and Chairmaking, 407
  Catering, 347
  Examinations Board, 152
  Exploratory conferences, 151
  Engineering, 273 *et seq.*
  Fuel Technology, 406
  Gas Engineering, 408
  Heating and Ventilating Engineering, 409
  Insignia Award, 152, 279
  Leather Technology, 411
  Paper Technology, 416
  Petroleum and Petroleum Products, 416
  Teachers' Courses, 538
  Technical Teachers' Certificate, 152
  Technological Certificate, 114, 284
  Textiles, 422
Civil Engineering, H.N.C., 266, 292
Civil Engineers, Institution of, 267
Civil Service Examinations, 380
Clerical Staff, 545 *et seq.*
Clock Making, 409 *et seq.*
Clothing Institute Ltd., The, 359, 401
Clothing technology, 400
Clothing trades, 35, 349
Coal Mining, 34, 401
Cockerton Judgment, 3
Coleg Harlech, 190
College advisory committees, 131 *et seq.*
College Associateships, 85
College-based sandwich courses, 89 *et seq.*
College Diploma Courses, 84
College of Preceptors, 150
College, use of name, 9
Colleges and Schools of Art, List, 598 *et seq.*
Colleges of Art—
  function, 329
  number of, 8, 10
  staff, 329
  research, 330
Colleges of Commerce—
  distribution, 33, 361
  number, 8, 10
Colleges of Further Education, 8, 9, 47, 49, 125
Colleges of Technology, number of, 8
Colliery Managers' Certificates, 402
Colombo Plan, 455
Commerce, 361 *et seq.*
  Association of British Chambers of, 367
  Present controversies, 370
Commerce Colleges, 597 *et seq.*
Commerce, Courses—
  Degree, 364
  Full-time, 363 *et seq.*
  National Certificate, 367
  Part-time, 365
  Professional, 365
Commerce, The National Association for the Advancement of Education for, 167
Commerce students, lack of deferment, 81
Commerce, teaching methods, 382
Commercial and Industrial Education, The British Association for (B.A.C.I.E.), 167
Commercial art, 314 *et seq.*
Communications in industry, 519
Communications Institute, B.A.C.I.E., 519
Community service, 345
Concrete Practice Course, 301
Conditional Aid Funds, 191
Confectionery, 394
Consultants to industry, staff, 580
Cookery, courses, 334 *et seq.*
Cookery, National School of, 335
Co-operation between industry and education, 197 *et seq.*
'Co-operative' courses, American, 86
Corporate life in college, 524 *et seq.*
Cotton Board, 188, 422
Cotton industry, 35, 421
Counterpart Funds, 569, 584
County Colleges, 107 *et seq.*
  Content of courses, 115
  Education Act, § *43*, 107, 109
  Effect of bulge, 108 *et seq.*
  Future, 575
  Proportion now in attendance, 108
  Rural arrangements, 116
Course-work profiles, 125

Courses—
  Comparable courses in Science and Technology, Universities and Technical Colleges, 526
  Range and quality, 124 *et seq.*
  Recognitions under Circular 255, 610 *et seq.*
Craft Apprentices, 250
Craft courses, 114
Craft, definition, 447
Craft students—
  Ability of, 226 *et seq.*
  Previous schooling, 228
Craft training, 572
Crafts Centre of Great Britain, 327
Craftsman Certificate, National, 160
Cremer Report on Chemical Engineering, 398, 400

DANISH FOLK HIGH SCHOOLS, 116
Day Continuation Schools, 50, **186**
Day course, standards of, 125 *et seq.*
Day-release problems, 199 *et seq.*
Day-release courses (see also Part-time day courses), 112
  County College Group, 105 *et seq.*
  Beyond County College Group, 205
  and Evening Classes, 206
  from various industries, 110 *et seq.*, 198
  Problems of, 197 *et seq.*
Deck Officers, training, 414
Deferment of National Service, **79** *et seq.*, 101, 107, 368
Degrees, American, 459
Department of Scientific and Industrial Research (D.S.I.R.), 196, 623
Departmental Heads' meeting, 505
Departments, growth of, 36, 426
Depressed areas, 36
Design and aesthetics (new buildings), 559
Design and function (new buildings), 558
Design centres, 327
Design, National Diploma in, 314
Designers, 314
Dietetic Association, British, 349
Diploma courses—
  Higher, 84
  Higher National, 85, 114
  Entries and Awards, 155
Diploma in Technology (Dip.Tech.), 469, 577, 578 *et seq.*
Diplomas, Awarded in European countries, 456
Directed practical training, 403
Domestic courses, 336
Domestic Studies, National Council of, 337, 359
Dress Design, 315
Dressmaking, 332 *et seq.*
Duke of Edinburgh's Conference, 189

'EARLY LEAVING' REPORT, 244, 574
East Midland Educational Union (E.M.E.U.), 147
Education Act, 1944—
  § *39* Further Education, 3
  § *41*, 3 *et seq.*
  § *43*, County Colleges, 107 *et seq.*
  Minister's Powers, 481
Education, Central Advisory Council for, 574
Education Committees, Association of, 532
Education Department in firms, 186
Education for flexibility, 180, 566
Education for Industry and Commerce, National Advisory Council, 470
  Constitution, 614
  1950 Report, 480
Education for quality, 566
Education, Journal of, 540
Education, officers in industry, 210
Education schemes in industry, 183 *et seq.*
Educational psychology, list of researches, 586
Educational Research, National Foundation for, 581
Educational societies, addresses, 616 *et seq.*
Electrical Association for Women, 340, 345
Electrical engineering—
  Ordinary National Certificate, 264
  Higher National Certificate, 264
  Sandwich Courses, 270
Electrical Engineers, Institution of, 265
Electrical installations work, 277
Electrical Technicians, Report on, 579
Eleven-plus examination, 83
Embroidery, 317, 334
Employees, selection of, 223 *et seq.*
Employers' Confederation, British, 190
Employment, changes in, 176 *et seq.*
  and day release, 112
Employment and Training Act, 1948, 235
Engaged couples, courses for, 338
Engineering apprentices, 251
  Works training, 249
Engineering, branches of, 248
Engineering, College graduate apprentice, 252
Engineering courses, 245 *et seq.*
Engineering, City and Guilds course, 273 *et seq.*
Engineering craft apprentices, 250

Engineering, definitions of, 245 *et seq.*
Engineering Education, American Society for, 86
Engineering Joint Examinations Board, 260, 625
Engineering Laboratory Practice, Bulletins, 540
Engineering, London University degree, 253
Engineering, origins of, 245
Engineering, training in, 247
English, 519
Enrolment week problems, 237 *et seq.*
Entry standards, 78, 224
Eotechnic phase, 38
Equal pay, 532
Equality of opportunity, 229
Equipment, 550 *et seq.*, 561
  Gifts from industry, 562, 564
  Obsolescence of, 185
Escalation between courses, 115, 232
Establishments of Further Education, 3
Evening classes, 118 *et seq.*
  Difficulties, 119 *et seq.*
  Range of subjects, 117
Evening institutes and technical colleges, 122
Examinations—
  National Certificate, assessed, 157 *et seq.*
  Work of Professional Institutions and Examining Bodies, 143 *et seq.*
Exchange of Students (I.A.E.S.T.E.), 214, 217
Exchange of Teachers, 539
Executive Development Programme (B.I.M.), 212 *et seq.*
Exhibition, *1851*, *1862*, 21
Experiments, Notes for Guidance and Suggestions, 541
Export trade, 379
External degree system, 160
External relations, 533, 580

FABRIC DESIGN, 317
Factories, H.M. Inspector, 562
Failure, causes of, 225, 433, 515
Federation of British Industries, 181, 189
Fermentation industries, 443
Festival of Britain, 21
Finance, 481
Financial and administrative considerations, 494
Financial grants by Local Education Authorities, 525 *et seq.*
Fine Art, The Slade School of, 324
Firms, influence on students, 230
Firms, manufacturing, size of, 200
First Aid, 339, 343
Fisher Act, 22, 109, 575
Flax processing, 35
Flexibility, education for, 180, 567
Flexibility in courses, 451
Folk High Schools, Danish, 116
Food Technology, 403
Foreign languages, 378
Foreign students, 571
Foremanship courses, 296, 375
Foster parents, courses for, 342
Foundry technology, 404
Frankland Chemical Society, 49
Freedom and education, 481 *et seq.*
Freedom and governance, 481 *et seq.*
Fuel Technology, 405
Full Technological Certificates (City and Guilds), 114
  Building crafts, 284
  Engineering, 251, 275, 277, 278
Full-time Courses, 69 *et seq.*, 515
  Analysis of age groups, 82
  Future, 573
  Recruitment and Qualifications, 84 *et seq.*
  Students from part-time courses, 92 *et seq.*, 573
Full-time education, U.K. and U.S.A., 5
Full-time students, 515, 524
Funds, Conditional Aid/Counterpart, 569, 584
Furniture design, 317
Furniture in colleges, 562
Furniture technology, 406
Further Education
  § *39* of Education Act, 3
  Colleges of, 8, 9, 47, 49, 125, 576
  Increase of enrolments, 6, 7
  Pamphlet No. *8*, 576
  Range of subjects and activities, 7, 8
  Total enrolments, *1952/53*, 4
Further Education Establishments
  Local colleges, 576
  Technical colleges, 8, 10
  Types of, Table *3*, 8

GAS COUNCIL, 616
Gas engineering, 407
General Certificate of Education, 83, 220, 574
General education
  continued, 115, 567
  defects in, 242
  in a Free Society, 521
General Nursing Council, 350
Geological/Geographical factors, 32 *et seq.*
Gifts from industry, 214, 562
  Income tax rebate, 562
Girls' Clubs and Mixed Clubs, National Association of, 193

Good Housekeeping Institute, 345, 359
Governance of colleges, 481 *et seq.*
Governing bodies, 130 *et seq.*, 486
Government and Public Offices, 615
Government Training Centres, 195
Graduate apprentice, 252
Graduate wives, 466, 480
Grammar schools (see also Secondary schools), 574
Grantley Hall, courses, 192
Graphic arts and design, 418 *et seq.*
Growth of colleges, 32, 560

HAIRDRESSING, 351
Half-day release, 207
Hand embroidery, 317, 334
Harvard Committee Report, 521, 529
Heads of Departments
  meetings, 505
  salaries, 533
Heads of financial estimates, 494 *et seq.*
Health education, 342
Health Visitors, courses, 351
Heating and Ventilating Engineering, 279, 408
Heating and Ventilating Engineers, Institution of, 409, 618
Higher Diploma courses, 84, 114
  Table 24, list of awards, 155
Higher Diploma sandwich courses, 91 *et seq.*
Higher National Certificates, 15
  Awards, 155, 157 *et seq.*
  Building, 290
  Chemical Engineering, 399
  Civil Engineering, 266
  Commerce, 367
  Courses, 113
  Electrical Engineering, 264
  Gas Engineering, 408
  Mechanical Engineering, 258
  Physics, 436 *et seq.*
  Previous education of holders, 224 *et seq.*
  Production Engineering, 261
Higher National Diploma
  Awards, 155
  Building, 294 *et seq.*
  in Engineering, 270
  Sandwich Courses, 86 *et seq.*
Higher technological education, 446 *et seq.*
  Ability in the population, 462
  A.T.I. Policy Report, 473, 491
  Definition, 447
  Parliamentary and Scientific Committee Report, 454, 578
  Post-war proposals, 468 *et seq.*
  Post-war requirements, 453 *et seq.*
Hillcroft College, 190
History, 519
H.M. Inspector of Factories, 562
H.M. Inspectors, Education, 134, 146, 148, 156, 539, 556, 561
  General Inspections, 543
Home influence, 228 *et seq.*
Homemaking, classes for men, 355
Homemaking, signposts of, 360
Homemaking, training by other organisations, 340
Home nursing, 343
Horology, 409
Horticulture, 410
Hosiery trade, 35
Hostel accommodation, 524, 563
Hotel and catering, 33
Hotel and Catering Institute, 346, 347 *et seq.*, 359
Houseworkers, National Institute of, 341, 342, 345
Human relations, 350, 341
Humanities, 519 *et seq.*

I.A.E.S.T.E., 214, 217
Income tax rebate on gifts, etc., from industry, 214, 562, 564
Individual Efficiency, Joint Committee on, 180
Induction courses, 185
Industrial Administration, Institute of, 212, 372
Industrial Art Bursaries, 154, 321
Industrial Artists, The Society of, 323
Industrial Catchment Area, 39 *et seq.*
Industrial Councils, National Joint, 190, 572
Industrial Design, The Council of, 322
Industrial Designer and Consultant, 317
Industrial Engineering A.A.C.P. Report, 388
Industrial Productivity, 457
Industrial Psychology, The National Institute of (N.I.I.P.), 191, 235
Industrial Rehabilitation Units, 195
Industrial Research, Department of Scientific and (D.S.I.R.), 196, 623
Industrial Welfare Society, 188
Industries, Federation of British (F.B.I.), 189
Industries, siting of, 36 *et seq.*
Industry and Commerce
  National Advisory Council on Education for, 141, 470, 614
  Representation on Governing Bodies, 501
Industry and education, 172 *et seq.*
  co-operation between, problems of, 197

Industry, Trade and Finance, *Manchester Guardian Survey*, 180
Inert ideas, 511
In-service teachers' training courses, 537
Insignia awards in technology (City and Guilds), 152, 279
Inspection of colleges, 543
Inspectors, H.M., 134, 146, 148, 156, 539, 556, 561
Institutional Management Association 348
Insurance Institute, Chartered, 365, 619
Intelligence and aptitudes, 225 *et seq.*
  in the population, 462
  and potential university intake, 464
Intelligence, range of, in occupations, 231 *et seq.*
Interests and occupational choice, 234
Internal administration of colleges, 502 *et seq.*, 545 *et seq.*
Internal degrees, London University, 162
Interrelation of courses, 74 *et seq.*
Invalid cookery, 350
Interviewing of candidates, 545
Iron and steel industry, 34

JOBS INSTRUCTION, RELATIONS, METHODS, 195
Joint Committee for Awards of National Diplomas and Certificates, 154 *et seq.*, 621
  Constitutions, 156
  Building, 287
  Commerce, 368
  Representation on, 155 *et seq.*, 497, 621
Joint Consultative Committee of industry, 190
Joint Education Committees, 40, 489 *et seq.*
Joint Matriculation Board, 149, 574
Joint Recruiting Board, 80
Jute Technology, 35

LABORATORY EXPERIMENTS, NOTES FOR GUIDANCE, 541
Laboratory practice, 540
Laboratory technology, 445
Labour Colleges, National Council of, 189
Lancashire and Cheshire Institutes (see Union of).
Languages, modern foreign, 378
Launderers, The Institution of British, 619
Laundry, 352
Leadership, qualities of, 464 *et seq.*
Leather technology, 411
Leisure classes, part-time day, 118
Liberal education, 115, 518 *et seq.*, 583
Liberal Education in a Technical Age, Report, 518
Librarianship courses, 379, 58
Licensed trade, courses, 349
Local College of Further Education, 8, 9, 47, 49, 125, 576
London Polytechnics, foundation of, 14 *et seq.*, 22, 63, 64
London University, external degree courses, 160 *et seq.*
  Chemistry, 431
  Commerce, 361, 366
  Engineering, 253 *et seq.*
  General, 436
  Physics, 436
London University, degree courses, 85, 160
  part-time day courses, 112 *et seq.*

MACHINE EMBROIDERY, 349
Machine shop engineering, 273
Madingley Hall, Cambridge, management courses, 192
'Make do and mend' courses, 339
Maladjusted students, 516
'Man in Society', course on, 520
Management, education and training, 180, 209
  British Institute of, 211, 187, 372, 471
Management studies
  Courses in universities, 192
  Diplomas in, 212
  Education and Training for F.B.I. Handbook, 181
  in Building courses, 294, 296 *et seq.*
  Industrial Consultants, Register of, 211
  in Sandwich courses, 92
  Professional institutions, 194, 376
  Qualifications, 79
Manchester and District Advisory Council, 136, 139
Manchester Guardian Survey, 180
Man-made fibres, 35
Manufacturing firms, sizes of, 200
Marine Engineering, 412
Market research, 377
Markham-Hancock Report, 341
Marriage Guidance Council, 340
Marriage, preparation for, 337
Mastic asphalt courses, 287
Mathematics, 438 *et seq.*
Meat and Other Foods, Inspectors of, 300

Mechanical engineering
  Design, City and Guilds, 279
  Inspection, 274
  H.N.C. courses, 258
  O.N.C. courses, 255
  Sandwich courses, 269
Mechanical Engineers, Institution of, 154, 259
Mechanics' Institutes, 14, 49, 50, 52, 56, 60
Membership of professional institution, 157 *et seq.*
Metallurgists, Institution of, 441, 619
Metallurgy, 426, 440 *et seq.*
Metalwork
  Art, 316
  Sheet, 275
Methods engineering, 375
Middle-aged, retraining of, 358
Military College of Science, 527
Millinery, 353
Miners' Welfare Fund, 34
Mining Colleges, 34
Mining education, 34, 401
Ministry of Agriculture and Fisheries, 615
Ministry of Education, 615
  and Art education, 327
  Inspections of colleges, 543
  and Joint Committees, 154, 621
  Short courses, 538
Ministry of Fuel and Power, 615
Ministry of Health, 615
Ministry of Labour and National Service, 615
  and deferment, 79
  Reports on manpower, 455
  Special Aptitude Scheme, 195
Mixed Clubs and Girls' Clubs, National Association of, 193
Modern Schools (see Secondary Modern Schools).
Motor Industry, Institute of, 278
Motor vehicle work, 278
Municipal engineering, 268
Municipal Engineers, Institution of, 269

National Advisory Council on Education for Industry and Commerce, 141, 470
  Constitution, 614
National Certificates
  and Regional Examining Unions, 148
  Countersignature of, 161
  List, 621
  Schemes, 113 *et seq.*
National Certificate students
  ability of, 226 *et seq.*
  previous schooling, 228
National Certificate courses, 111, 114, 148, 154 *et seq.*
  Building, 287
  Chemical engineering, 399
  Chemistry, 426, 432
  Commerce, 367, 370
  credit standard, 158, 265
  Engineering, 255
  Gas engineering, 407
  Metallurgy, 440 *et seq.*
  Mining, 402
  Naval architecture, 413
  Physics, 436
  selection and progress, Diagram 25, 239
  Textiles, 422
National Coal Board, 402, 616
National Colleges, 11, 391, 603
  Aeronautics, 392
  Food Technology, 403
  Foundry Technology, 404
  Heating, Ventilating and Refrigeration Engineering, 408
  Horology, 409
  Leathersellers, 35, 411
  Rubber Technology, 420
National Committee of Enquiry into Vocational and Non-Vocational Education, 518
  Liberal Education in a Technical Age, 518
National Craftsman Certificate, 160, 278
National Diploma in Design, 314, 319
National Diplomas, 84, 85, 114, 155
  Agriculture, 394
  Engineering, 255
  List, 621
National Joint Industrial Councils, 190, 572
National Retail Distribution Certificate, 160
National Service
  Deferment of, 79 *et seq.*, 107
  Preparation for, 187
Nautical courses, 414
Naval Architecture, 413
Navigation, 414
Needlecraft subjects, 332 *et seq.*
Neotechnic phase, 38
New National Award, Advanced Technology, 469, 577, 578 *et seq.*
'Ninth Examining Body' (Associated Examinations Board), 152
Non-examining Partnerships, 163 *et seq.*
Northern Counties Technical Examinations Council (N.C.T.E.C.), 147
Northern Ireland, Ministry of Education, 615
Northern Universities, Joint Matriculation Board, 100
  Joint Scheme with U.L.C.I., 149
Note-taking, 544

Nursery Examination Board, National, 350
Nursing Council, General, 350
Nursing, courses, 350
Nutrition, Royal Sanitary Institute Certificate, 349

Occam's Razor, 424
  for administrators, 501
Occupational Psychology, 191
Occupations, choice of, 232
Office Management Association, 373
Office staff in colleges, 545
Oil technology, 415
Open Days, College, 547, 548
Operative training, 579
Optics, 441
Ordinary National Certificate courses, 157 *et seq.*
  Awards, 155, 256
  Building, 287
  Commerce, 367
  Electrical Engineering, 264
  Mechanical Engineering, 255
Ordinary National Diploma courses, 84
  Awards, 155
  Engineering, 255
Other technologies and crafts, list, 392
Out-county fees, 493
Out-county student, the, 492 *et seq.*
Outward Bound School Organisation, 116, 193
Overseas students, 571
  Handbook for, 585
Oxbridge, 16

Paint technology, 416
Painters' and decorators' work, 282, 285 *et seq.*
Paleotechnic phase, 38
Pamphlet No. 2: Guide to Educational System, 30
Pamphlet No. 3: Youth's Opportunity, 116, 394
Pamphlet No. 4: Building Crafts, 304
Pamphlet No. 6: Art Education, 331
Pamphlet No. 8: Further Education, 30, 112, 394, 491
Pamphlets, C.Y.E.E., M.L.N.S., A.A.C.P., A.T.I., 391 *et seq.*
Paper technology, 416
Parliamentary and Scientific Committee Report, 454, 473, 578
Parochial Charities Act, City of London, 45, 63, 64
Partnerships in technical education, 128
Part-time day courses, 104 *et seq.*, 575
  Analysis of release from industries, all ages, 106
  County Colleges, 105 *et seq.*
  Day release courses, main types, 112 *et seq.*
  Future, 109, 197
  Increase of, 105 *et seq.*
  Number of students, 105
  Transfer from, 515, 573
Part-time day students, 513 *et seq.*
Part-time teachers
  City and Guilds Certificate, 538
  Handbook for, 540, 549
  Training Courses, 534, 538
Percy Committee Report, 136, 408, 453, 468 *et seq.*
  detailed analysis of, 472 *et seq.*
Personal qualities, 512, 569
Personal studies, 339
Personnel management, 373
Pharmaceutical chemistry, 444
Pharmacy, 443 *et seq.*
Phasing of buildings, 559
Photography, 442
Physical culture, 342 *et seq.*
Physico-chemitechnic phase, 38
Physics, 426, 435
  National Certificates, 436
Physics, Institute of, 437, 620
Pigments, technology, 416
Placement in courses, 223
Plastering courses, 282, 286
Plastics Institute, 418, 620
Plastics technology, 417
Plumbing courses, 282 *et seq.*
Policy and administration, 502 *et seq.*
Political and Economic Planning (P.E.P.) pamphlets, 243, 620
Polytechnics
  examples, 63, 64
  foundation, 22
  number, 8
  particulars of, 592-3
Population, changing structure, 182
Population factor, 32 *et seq.*, 39, 44
Port-working, courses, 379
Post Graduate/Advanced courses, 434, 437, 439, 452, 470, 577
Post-graduate college, 471
Pottery, 397
Pottery Manager's Certificate, 397
Preceptors, College of, 575
Preliminary senior technical courses (P.S.T.), 256
Principals of Technical Institutions, Association of, 9, 10, 164
Principal's position, 487 *et seq.*, 500, 503 *et seq.*
Printing, courses, 418
Prix de Rome, 309
Production Engineering
  Higher National Certificate, 261
  Higher National Diploma sandwich course, 271

Productivity Committees, Local, 187, 216
Professional courses, 85
Professional Institutions, etc., 144, 157, 194, 366
  addresses, 616 *et seq.*
Professional Institutions and examinations, 143
  Associate Membership of, 158
  Chemical Engineers, 399
  Civil Engineers, 267
  Mechanical Engineers, 259 *et seq.*
  Electrical Engineers, 265
  Production Engineers, 263
  Structural Engineers, 291
Professional People, 79
Professional status, 79, 194
Prospectuses, 547
Public Health Inspectors, 301
Public Health, Royal Society for, 300
Publicity, 546
Purchasing Officers' Association, 373, 620
Pure Chemistry, National Certificate, 431 *et seq.*

QUALIFICATIONS GAINED BY TECHNICAL COLLEGE STUDENTS, 475
Qualified teacher status, 537

RADIO ENGINEERS, BRITISH INSTITUTION OF, 277
Radio Officers (Marine), 414
Railway carriage and wagon construction, 279
Railways traffic apprenticeships, British, 154
Rayon manufacture courses, 35
Recognition of courses, Circular *255*, 610 *et seq.*
Recording attendances and progress, 208
Recoupment, further education regulations, 493
Recreational classes, 343
Recreative Physical Training, The Central Council for, 343
Recruiting Board, Joint, 80
Recruitment of students, 76 *et seq.*
Recruitment and manpower, 181 *et seq.*, 214, 453
Redbrick University, 12, 563
Refresher courses—
  Advanced technology, 470
  Management, 374
  Women's subjects, 355
Refrigeration engineering, 261, 408
Regional Academic Boards, 138
  Percy Committee Report, 470
Regional Advisory Councils, 135 *et seq.*
  as Examining Bodies, 142, 143
    List of, England, 614 *et seq.*
      „ Scotland, 615
      Wales, 615
Regional arrangement of courses, 41
Regional College of Art, 54, 325
Regional Colleges of Technology 125, 454, 477, 491 *et seq.*, 577, 578
Regional Examining Unions, 146 *et seq.*
  Addresses, 616
  Concordat with City and Guilds of London Institute, 149 *et seq.*
  Examination results, *1953*, 148
  National Certificates gained, 149
  Standing Conference, 150
Registered lodgings, 524
Relations with industry, 172 *et seq.*
Relationship of staff with students, 505 *et seq.*
Reports to firms, 208 *et seq.*
Representation of industry and commerce, 501 *et seq.*
Research, 196, 345, 434, 437, 439, 469, 539, 542, 580, 581, 584
Research Associations, 196, 569, 580, 585
  List of, 621 *et seq.*
Residential accommodation, 472, 524, 563 *et seq.*
Residential courses, 192
Retail Distribution Certificate, National, 160
Retail establishments, sizes of, 200 *et seq.*
Road Transport, Diploma in, 154
Roffey Park Institute, 188
Rooms, specialised, 561 *et seq.*
Royal College of Technologists, 472
Royal Colleges of Technology, 471 *et seq.*
Royal Society of Arts, 153, 321
Rubber Industry, Institution of, 421, 620
Rubber technology, 420
Ruskin College, 190

SABBATICAL LEAVE, 539
St. John Ambulance Association, 343
Salaries of teaching staff—
  scales, 533
  scales, Scotland, 533
Sandwich Courses, main details, 86 *et seq.*, 514, 527, 579
  in building, 295
  in commerce, 364
  in engineering, 269 *et seq.*
  in gas engineering, 408
  for sanitary inspectors, 301
  future, 576
  grants, 527
  list of colleges with, 623
  original courses, 60, 86

Sandwich Courses—*cont.*
  payment of wages, 92
  Percy Committee Report, 471
Sanitary Inspectors' courses, 299
Sanitary Inspectors' Examinations Joint Board, 300
Sanitary Institute, Royal (now Royal Society for Public Health), 300
Schedule of accommodation, 556
Scholarships and awards, 507, 525 *et seq.*
  National Coal Board, 527
School leavers, 513
  Report on Early Leaving, 574
School leaving age, raising, 568
School leaving certificate, 257
School Science Review, 541
Science, increased importance and impact of, 35 *et seq.*, 175, 450
Science departments, 426 *et seq.*
Science Technologists' Association, 445
Sciences, 423
Scientific and Industrial Research, Department of, 196, 569, 616, 623
Scientific education, 18
Scientific Policy, Advisory Council on, 455, 459, 461
  Reports, 569
Scientific Manpower, Barlow Committee on, 453 *et seq.*, 461, 463
Scientific Manpower, women's contribution, 465 *et seq.*
Scotland, National Certificates—
  in Commerce, 369
  in Engineering, 257
Scotland, Regional Advisory Councils, 142
Scottish Central Institutions, 492, 606
Scottish Education Department, 615
Secondary Schools, relation with colleges, 573 *et seq.*
Secondary grammar schools, 18, 189, 305, 362
  and H.N.C. results, 224 *et seq.*
  and O.N.C. and craft students, 228
Secondary modern schools—
  and H.N.C. results, 224 *et seq.*
  and pupils in O.N.C. and craft courses, 257
Secondary technical schools, 94 *et seq.*
  future, 100, 574
  and H.N.C. results, 224 *et seq.*
  number of, 95
  pupils in, 96
  ratio to grammar/modern schools, 95
  relation to technical colleges, 96 *et seq.*
Secretarial courses, 362
Secretaries, Institute of Chartered, 365, 620
Selection and placement, 218, 507
  comparison with American Universities, 221 *et seq.*
Selection in industry, 223 *et seq.*
Selection methods, 221
Selection through training, 241 *et seq.*
Services, supply of, 561
Seven-point plan, N.I.I.P., 236
Sheet metal work, 275
Shift work, 208
Shipping and forwarding, 379
Shoe technology, 396
Shorthand, 363
Site for a new building, 557
Size and morale, 180
Size of Colleges, 126, 531
  Manufacturing firms, 181, 200
  Retail establishments, 201
Skills, 581
Slade School of Fine Art, 324
Slating and tiling, 287
Smoke abatement, 405, 406
Social factors, 32
Social mobility, 516
Social studies, 49, 339, 520 *et seq.*
Special areas, 36, 48
Special rooms (new buildings), 561
Specialisation, problems of, 519
Spens Report, 94
Staff appointments, 499 *et seq.*, 545
Staff and students, 505
Staff College, Administrative, Henley, 188, 213, 373, 519, 523
  British Railways, 373
  National Coal Board, 373
Staffing and administration, 531 *et seq.*
Staffing of colleges in relation to industry, 213
  Commercial colleges, 383
  Women's subjects, 352
Staffing ratios, 542
Standards of day courses, 125 *et seq.*
State Scholarships, Technical, 471, 527 and footnote
Status of colleges, 577
Steelwork, fabrication of, 279
Strain in students, 516
Structural engineering courses, 291
Structural Engineers, Institute of, 291
Structure of certain industries, 202 *et seq.*
Students—
  Adult, 509
  Full-time, 515
  Needs and problems, 509 *et seq.*
Students' counsellor, 581
Students' grants, 527
Students, influence of firms on, 230
Students from overseas, 571
  Handbook, 585
Students' Union, 524

Students' vacation work, 87, 101, 214
Studies, Board of, 504
Success in courses, factors affecting, 225 *et seq.*, 433, 515
Summer Schools, Metropolitan-Vickers, 185
Supervisors, courses, 375
Surveyors, Royal Institution of Chartered, 293, 620

Tailoring, 353
Teacher exchange, 539
Teachers in Technical Institutions, Association of, 156, 165, 532
Teachers' return to industry, 540, 213
Teaching aids, 544
  methods, 543
Teaching hours, contact, 541
  and Research, 542
Teaching staff—
  Appointment, 545
  and Industry, 213
  Selection, 545
Teacher Training, 152, 335, 353, 534 *et seq.*
  Books on methods, 540, 549
  Colleges, 606
  In-service course, 537
  Ministry of Education short courses, 538 *et seq.*
Tea-time classes, 121
Technical, Art, Commerce Institutions, volume of work, Table *5*, 11
Technical colleges—
  and evening institutes, 122
  Number, 8
Technical education—
  development of, 14 *et seq.*, 21 *et seq.*
  effect of classical tradition, 16 *et seq.*
  literature of, 540
  range of institutions, 8
  relation to Oxbridge, 16
  in relation to technological education, 12, 13
  social history, 14
  technical degrees, comparison of U.K. and U.S.A., 459
Technical high schools, 94
Technical institutes, number of, 8, 10
Technical Institutions, Association of (A.T.I.), 10, 163 *et seq.*, 587
  Association of Principals of, 164, 587
  Associations Representing Technical Institutions and their staffs, 603
  Copies of A.T.I. Papers, 171
  List of, 587 *et seq.*
  Policy Reports, 473, 491
  Teachers' Association, 165
Technical Secondary Schools (*see* Secondary Technical Schools).
Technical State Scholarships, 527
Technical Teacher Training Colleges—
  Entrants, Table *49*, 535
  Increased output, 537
  List of, 606
  and Research, 581
  Students' first appointments, Table *50*, 536
Technicians, importance of, 579
Technological development, phases, 38
Technological education, 13, 446 *et seq.*
Technologists, College of, 473
Technologists, Royal College of, 471, 472
Technology—
  Colleges of, 468
  Institutes of, 454
  National Schools of, 468
Technology, City and Guilds Insignia Award, 152, 279
Technology, definition, 447
Telecommunications engineering, 275
Telegraph Engineers, Society of, 265
Terms of reference, Advisory Committees, 132
Textile industries, technology, 35, 421
Textile Institute, 421
Textile Training Guild, 185, 422
Timber Technology, 406
Townswomen's Guilds, 340
Trade Defence Association, National, 349
Trades Union Congress, 189, 190
Trades Unions, 189
  Management training, 375
  and Productivity, 375
Training Centres, Ministry of Labour, 184
Training Centres in industry, 186
Training Guild, Salford and District, 185
Training schemes in industry, 181, 183 *et seq.*
Training within industry (T.W.I.), 186, 195
Transfer of students, 114 *et seq.*, 207, 241
Transport, influence of, 39, 40
Transport, Institute of, 365, 620
Trichologists, Institute of, 351
Typewriting, 363

U.N.E.S.C.O. publications, 27, 549
Union of Educational Institutions (U.E.I.), 147
Union of Lancashire and Cheshire Institutes (U.L.C.I.), 15, 100, 143, 146, 257, 299, 349, 574
Universities and University Colleges, list of, 605 *et seq.*

Universities—
  Affiliation with, 57, 58, 59, 60, 61, 64, 162, 497
  British Commonwealth Year Book, 27
  and Commercial education, 380
  and Governing Bodies, 131
  Important books on, 12
  and Industry A.A.C.P. Report, 101, 189, 456
  and Technical colleges, 11, 19, 160, 498
  Technology in, 453 *et seq.*, 467, 605
University awards, Ministry Report, 220
University Grants Committee, 454, 606
University residence, analysis of, 563
Urchfont Manor, courses, 192
U.S.A. co-operative/sandwich courses, 86
  Full-time education, 5
  Productivity reports, 27
  Vocational training of adults, 27

VACATION WORK AND STUDY, 101
Varnishes, technology, 416
Vehicle repair and maintenance, National Craftsman Certificate, 160
Ventilation engineering, 408 *et seq.*
Vice Principals, 533
Visual aids, 544
Visual education, 544, 549
Vocational adult education, 193
Vocational Aspect, 540, 548
Vocational courses, conditions for success, 78
Vocational full-time courses, 83 *et seq.*
Vocational guidance—
  Conferences, 235
  Diploma, 237
  Schemes, 236
Vocational training for women, 346
Voluntary interests/activities, 130

WALES, ADVISORY COUNCIL FOR, 141 *et seq.*

'Wastage' in courses, 119, 238 *et seq.*, 514, 581
Watch making, 409
Water Engineers, Institution of, 269
Welding, 275
Welsh Trading Estates, 36 *et seq.*
'Whiskey Money', 22, 100
Women's Advisory Council on Solid Fuel, 340, 359
Women's Gas Federation, 340, 345, 359
Women in employment, 356, 360, 466
Women's Institutes, National Federation of, 340, 359
Women Students, 466
Women's subjects, enrolments, 332 *et seq.*
Women technical teachers, training, 354, 536
Women's vocational training, 346, 356
Wool Secretariat, International, 327, 422
Wool textile industry, 35
Work profiles of colleges, 71, 73, 77
Work study, 375, 390
Workers' Educational Association (W.E.A.), 4, 190, 620
Works based 'sandwich' courses, 89 *et seq.*
Works Managers, Institute of, 373
Works Schools, 186, 603
Works Summer Schools, 185
Works training, engineering apprentices, 249

YORKSHIRE COUNCIL FOR FURTHER EDUCATION, 135 *et seq.*, 143
Young workers' courses, 193
Youth Employment Executive, Central, 190
Youth Employment Officers, National Association of, 237
Youth Employment Service, 195, 230, 234 *et seq.*
Youth's Opportunity, Ministry Pamphlet, *116*, 394

NAME INDEX

Abbott, W., 29, 135, 169
Adamson, J. W., 27, 29
Alexander, W. P., 30, 99, 103, 480, 548
Allport, G. W., 244
Anderson, D. S., 170
Ashby, Eric, (now Sir) 244, 464, 465, 479
Atkins, A. A., 217

Bacon, Francis, 246, 524
Bailey, G. L., 584
Bailleu, Sir Clive, 211
Baker, J. F., 529
Balfour, Sir Graham, 490
Barker, Sir Ernest, 17, 29
Bartlett, Sir Frederic, 180, 216, 572
Beaver, Sir Hugh, 217
Bellamy, R. G., 280
Beloff, Max, 26
Bernal, J. D., 28, 29, 430, 529
Berry, A., 331
Beveridge, Lord, 529
Beveridge, W. I. B., 430
Bingham, J. H., 388
Birley, R., 17, 29
Blackett, P. M. S., 28
Blackwell, A. M., 586
Bonham-Carter, A. D., 388
Bragg, Sir Lawrence, 28, 243, 477
Brambell, Professor F. W. Rogers, 530
Branton, N., 388
Bray, F., 128, 330, 388
Broadbent, H. W., 388
Brookes, J. H., 27
Brown, J., 128
Brugere, R., 25
Buchanan, Sir John, 214, 218
Buck, Pearl, 360
Burckhardt, G. N., 435
Burnham, T. H., 388
Burns, T., 390
Burt, Sir Cyril, 528
Burton, H. M., 394
Butler, R. A., 529, 586
Butterfield, H., 430

Cadbury, L. J., 127
Campbell, G. A., 435
Canner, J. L., 430
Carman, H. T., 28, 529
Carr-Saunders, Sir Alexander, 169, 220, 364
Carter, C. F., 584
Castle, P. F. C., 218, 244
Cave-Brown-Cave, T. R., 247
Chalmers, Paul, 101
Chanter, A. J., 586
Chapman, W. R. C., 243
Charlesworth, L. E., 243
Cherwell, Lord, 454, 530
Churchill, Sir Winston, K.G., 25, 523, 530, 564
Clark, D., 388
Clarke, G. A. F., 102
Clarke, Sir Fred, 583, 584, 586
Clarke, N., 437
Cockcroft, Sir John, 28
Cohen, Emmeline W., 495, 508
Cohen, Professor John, 430
Collinson, H., 331
Conant, J. B., 27, 101, 430, 520
Cook, F. P., 128
Corbett, L. J., 68
Costigan, H. A., 102
Cremer, H. W., 398, 400, 435, 529
Crewe, M. G., 435
Curtis, S. J., 101, 529

Dale, R. R., 243
Dampier-Whetham, W. C. D., 430
Danton, J. Perian, 388
Danckwerts, P. V., 478
Darwin, Robin, 330, 331, 392, 508
Darwin, Sir Charles G., 566, 584
Davies, J. Langdon, 360
Davies, Professor S. T., 27, 456, 479
Davies, V. C., 280
Dempster, J. J. B., 585
Denning, A., 26
Dennison, S. R., 528
Dent, H. C., 14, 26, 29, 127, 215, 394, 507
Diamond, T., 27
Dickey, E. M. O'R., 331
Disraeli, Lord, 570
Dobinson, C. H., 25, 26, 102
Dobson, Sir Roy, 215
Dolman, Olive I., 529
Dongerkery, S. R., 243
Drake, N. D., 416
Drakeley, T. J., 392
Dresden, D., 549, 584
Drucker, P. F., 388
Drury, F. E., 291
Dunn, Cyril, 243
Dunsheath, P., 388, 518, 528, 529

ECCLES, SIR DAVID, 477, 480, 527
Edgar, R., 102
Edwards, Professor R. S., 216, 585
Edwards, T. S., 389
Ellingham, H. J. T., 169, 426, 430, 435, 450, 478
Elmes, E. T., 331
Eshbach, O. W., 101
Evans, Kenneth R., 218
Eysenck, H. J., 244

FARRINGTON, B., 430
Findley, A., 430
Finer, S. E., 230, 244
Finlay, E., 170
Fisher, Norman, 403, 529
Fisher, W. G., 392
Fleming, C. M., 528
Fleming, Sir Alexander, 398
Fleming, Sir Arthur P. M., 215, 218
Flemming, Sir Gilbert, 503, 508
Flexner, Abraham, 12, 28
Flugel, J. C., 528
Foden, F. E., 170, 529
Ford, Boris, 528
Forman, M. B., 217
Foulds, G. A., 244
Fox, T. C. R., 26
Frankfurter, J., 508
Frazer, W. Lionel, 215
Frisby, C. B., 244
Frost, Harvey, 304
Fuller, Thomas, 580

GAINSBOROUGH, S., 102
Galton, Francis, 438
Geddes, Patrick, 37
Gibson, A. W., 171
Gibson, G., 392
Giffen, E., 280
Glass, D. V., 243, 528
Goldberg, E. M., 517, 528
Gonbitz, E., 389
Goodall, S. E., 169
Goodeve, Sir Charles, 584
Goodhart, A. L., 498, 508
Gordon, Lincoln, 19, 29
Gordon, Lord Dudley, 246
Graham, A. D., 528
Green, Ernest, 523, 530
Guy, E., 102

HAAN, HUGO DE, 388
Hale, Sir E., 101
Hall, J., 395
Halsbury, Lord, 584
Handley Page, Sir Frederick, 170, 521, 529, 530
Hankey, Lord, 471, 479
Harben, Philip, 341
Hardebeck, G. C. M., 26
Hargreaves, J., 414, 415
Harris, T. R., 528
Harshe, Professor C. D., 529
Hartley, Sir Harold, 398, 400
Harvey, A., 171
Haslegrave, H. L., 30, 171, 280
Haslett, Caroline, 360
Hawkins, T. H., 128, 218
Hearnshaw, L. S., 466, 585
Heilbron, Sir Ian, 508
Hemming, James, 218
Hempstock, T. A., 25, 548
Hetherington, Sir Hector, 467, 480
Higginson, T. H., 128
Hill, D. W., 435, 585
Himmelweit, H. T., 230, 243
Hird, Iain, 389
Hiscocks, G. M., 360
Hobson, J. E., 584
Hogben, L., 29, 430, 438, 439
Hogg, Quintin, 14, 46
Hollyn, E. H. T., 400
Holmes, K., 331
Holtby, Winifred, 360
Houldsworth, Sir Hubert, 403
Hubback, Eva M., 218
Hubback, Judith, 480
Hudson, D., 170, 330
Hume, K. J., 410
Hunt, Donald G., 101
Hunter, Guy, 28, 217, 530, 582, 586
Hurn, T. R., 528
Hutchings, Sir Robert, 585
Hutchins, R. M., 12, 28, 582, 586
Hutchinson, E. M., 528
Hutt, Professor A. L., 449, 478
Hutton, R. S., 529
Huxley, Professor T. H., 3, 30, 570, 585
Hytten, Professor T., 529

INCE, SIR GODFREY, 100, 103, 195, 216, 217
Ingram, Beresford, 549
Innes, J. H., 170
Isaac, S. F., 102

JACOB, W., 102
Jackson, Willis, 280, 480
James, Eric, 534, 535, 548
James, T. L., 26
Jamieson, C., 548
Jeans, Sir James, 430
Jenkinson, A. J., 29, 99, 101, 102, 170, 243, 548
Jephcott, Sir Harry, 183, 216,
Jessup, F. W., 586
Johnson, R. E., 584
Jones, F. C., 528
Jones, J. C., 170, 171, 480, 491, 508, 528

Jones, Professor P. Mansell, 25, 26
Jonson, Ben, 580
Jordan, L. A., 217, 585
Judson, A. S., 389

Kant, Emmanuel, 438
Kellaway, F. W., 549
Kelvin, Lord, 567
King, A., 389
Kipping, Sir Norman, 478, 565, 579, 584
Kisby, C., 331
Kitchen, P. I., 29, 109, 127, 216
Klingender, F. D., 243
Knight, Professor Rex, 529

Lahnhagen, R., 26
Lamb, J. P., 389
Larwood, H. J. C., 226, 243
Leese, J., 529
Lewis, Roy, 79, 101, 169, 217
Leybourne-White, Grace, 244, 462, 463, 479
Leyton, Elizabeth, 25
Liddiard, E. A. G., 584
Lindsay, A. S., 26
Lindsay, D., 280
Lindsay of Birker, Lord, 389
Livingstone, Sir Richard, 28, 512, 518, 522, 528, 529, 582, 586
Lloyd, Cyril, 128, 170, 529, 530, 585
Lock, H. F., 430
Lockspeiser, Sir Ben, 584
Logan, R. F. L., 517, 528
Lowery, H., 26
Lowndes, G. A. N., 22, 27
Luckhurst, K. W., 170, 330
Lynton, R. P., 389, 584
Lyon, H., 217
Lysaght, D. J., 548

McConnell, T. R., 28
McCulloch, N. G., 584
Mace, Professor C. A., 235, 241, 244, 359, 584
MacIntosh, D. R., 389
Mackay, R. A., 218
MacLennan, A., 128, 244, 548
McMurry, R., 389
McNicol, Grace, 387
Macrae, H. G. P., 169
Macrae, K. D., 102, 169
Magnus, Sir Philip, 150
Maitland-Edwards, J., 418
Major, R., 584
Malleson, N., 528
Malthus, 571
Mannheim, Karl, 528
Manson, J. L., 287, 288
Marriott, E. N., 217
Marsh, A., 406
Marshall, R. F., 170
Maude, Angus, 79, 101, 169, 217
Mavor, G., 545, 549
Mead, Margaret, 360, 528
Medsforth, S., 169
Mercer, F. A., 317, 331
Miles, R. S., 128
Mill, John Stuart, 502
Millis, C. T., 27, 29
Mills, H. R., 549
Mills, Sir Percy, 389
Mitchell, J. Howie, 389
Moberly, Sir Walter, 12, 28, 582, 586
Møller, T. C., 128
Monckton, Sir Walter, 389
Montrose, Professor J. L., 508
Morris, Sir Charles R., 19, 27, 29, 243, 466, 529
Morris, Sir Philip, 28, 480, 508
Mountford, Sir James, 243
Mumford, Lewis, 37-8, 68
Mumford, W. A., 530
Munson, C. S., 38, 68

Nash, G. J., 80, 101
Newitt, D. M., 400
Newman, J. H., 12, 28, 518
Newsom, J. H., 103, 482, 507
Newton, J. B., 26
Newton, L. J., 243
Nicholl, D., 549
Nicholson, J. H., 243
Nisbet, H. B., 170, 435, 492, 508
Nixon, J. H. R., 280
Novak, B. J., 26

Ogden, R., 217
Oliver, Professor R. A. C., 28, 483, 507
Ortega y Gasset, 12, 28

Painter, Macauley, 346
Parry, J. B., 244
Parsons, R. H., 280
Pascal, R., 243
Pawley, F. C., 548
Pealey, R., 102
Pear, T. H., 529
Peat, H., 549
Peers, Alison (Bruce Truscot), 12
Peers, Professor R., 20, 29
Peierls, R. E., 430
Pendred, L. St. L., 280
Percy, Lord Eustace (now Lord Percy), 23, 135, 136, 453, 468, 469, 499, 508
Perkin, W. H., 398
Perkins, F. H., 195, 216, 217, 389, 460, 461, 479, 530, 563
Phillips, J. E., 102
Pickard, O. G., 387

Pickup, J. R., 217
Playfair, Professor Lyon, 21
Pocock, C. A., 507
Potter, T. H., 387
Price, S., 168
Pulford, C. E., 170
Purdie, R., 102
Pye, Sir David, 429, 430, 448, 465, 478

Ratcliffe, R., 128, 528
Raven, T. C., 226, 244
Read, Sir Herbert, 331
Read, J. C., 528
Reay, M. H., 102
Reid, D. A. G., 217, 218, 389
Reid, F. H., 169, 480
Renold, Sir Charles G., 217, 389
Rice, Margery Spring, 360
Richardson, C. A., 549
Richardson, J. E., 392
Richardson, W. A., 27, 29, 94, 169, 545, 549
Rimmer, N. C., 389
Robbins, Brian G., 243
Robertson, S. M., 331
Robinson, H., 27
Robinson, Sir Robert, 49
Rodway, A. H., 331
Rose, A., 102
Rosenfeld, L., 26
Ross, A. M., 529
Ross, N. S., 218
Rossiter, A. P., 430
Rousseau, 387
Routh, D. A., 243, 530
Roy, A., 389
Russell, Earl Bertrand, 430

Sackett, D. M., 102
Safkin, T., 102
Salisbury, Lord, 454, 477, 480
Sargent, Sir John, 31
Saunders, P., 529
Savage, Sir Graham, 128
Savory, T. H., 430
Sawyer, W. W., 438, 439
Schachue, S., 416
Scheinfeld, Amram, 360
Schofield, Herbert, 46, 68, 185, 216
Schuster, Sir George, 234, 235, 244
Scorer, R. S., 406
Scott, E. W., 584
Scott, J. F., 389, 584
Scott, S. M., 331
Seliga, Stanislaw R., 26
Sheppard, K. W., 102
Shirley, R. W., 389
Sillitoe, Helen, 359
Simon, B., 26
Simon, Sir Francis E., 454, 478, 479, 585
Sinclair, Sir Robert, 389
Skinner, A. G., 388
Sleight, P. E., 169
Smail, J. Cameron, 508
Smedley, J., 529
Smith, Sir Ewart, 26, 456, 458, 459, 479, 585
Smith, K., 128, 244
Smith, Sir Rowland, 215
Smith, Professor W. O. Lester-, 486, 507, 508
Smout, Sir Arthur, 26, 479
Spencer, F. H., 549
Stalker, G. M., 590
Stephenson, George, 259
Stocks, Mary, 27
Stradling, Sir Reginald, 287, 292, 294, 298
Streat, Sir Raymond, 68, 456, 479
Synge, J. L., 430

Tait, J. S., 169
Tate, W. E., 586
Taylor, F. G., 331
Taylor, P. S., 27, 127, 507
Terry, L. A., 170, 388
Thompson, D. Cleghorn, 128, 218, 389
Thresher, B. A., 101
Tizard, Sir Henry, 584
Topping, J., 170, 438
Townend, D. T. A., 406
Toynbee, A. J., 582, 586
Tozer, A. H. D., 226, 243
Trevelyan, G. M., 28
Truscot, Bruce (Professor Alison Peers), 12, 16
Tustin, A., 28

Urwick, L., 388, 389
Uttley, T. E., 586

Varley, W. Mansergh, 171
Vaughan, E. B., 102
Venables, Ethel C., 226, 228, 244
Venables, P. F. R., 27, 29, 103, 128, 170, 215, 477, 478, 507, 528, 529, 549, 586
Verdon-Smith, Sir Reginald, 529
Vernon, P. E., 244
Vickers, Sir Geoffrey, 525, 530
Vidgen-Jenks, J. C., 331

Waddington, C. H., 430
Wallace, W., 127
Waller, M. C., 244
Warburton, F. W., 220, 221, 243
Warren, H. A., 280, 529
Watson, K., 128

Weddell, M., 360
Weeks, Sir Ronald, 169
Wells, H. G., 358, 360
Wells, M. M., 27, 127, 507
West, Sir Harold, 390
West, R. W., 508
Wheare, K. C., 502, 508
White, Amber Blanco, 360
Whitehead, A. N., 18, 29, 439, 511, 521, 522, 528, 529
Whittaker, J. M., 529
Whitworth, C., 508
Wilkins, L. T., 128, 244
Wilkinson, R. L., 528
William of Occam, 424
Williams, D. J., 128
Williams, Gertrude, 360
Williams, T. H., 102
Williams, T. I., 430
Wilson, J., 218, 390
Wilson, P. A., 169
Wilson, P. H. St. J., 390
Wilson, T. W., 529
Winterbottom, A., 390
Wolfenden, J. F., 243, 479
Wood, Sir Robert, 528
Woolf, Virginia, 360

York, T. J. P., 243
Young, A. P., 218

Zuckermann, Professor S., 216

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